

BROOKLYN BOTANIC GARDEN

PLANTS
&
GARDENS

BROOKLYN BOTANIC GARDEN RECORD

PLANTS & GARDENS

SPRING
1951

FLOWERING
SHRUBS

Kinds

Uses

Culture

NEW SERIES

VOL. 7

NO. 1



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PLANTS & GARDENS

Toringo Crab Apple (*Malus sieboldi arborescens*)

Vol. 7

Spring, 1951

No. 1

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Spring 1951

TO FRIENDS OF PLANTS & GARDENS:

What could be truer than the simple little verse of the child who wrote

Spring is here, spring is here
It always is this time of the year.

The first warm days when children dash out of the house without coats or hats, when soft winds woo life that has been dormant, and buds swell and burst -- these are the days when life for most of us starts anew. Yes, spring is the real beginning of the New Year.

ABOUT THIS ISSUE:

There was such wide reader interest a year ago in the Flowering Trees issue of PLANTS & GARDENS that we are devoting this entire issue to flowering shrubs. In round numbers, there are over 1,000 different kinds of flowering shrubs that are of practical interest in mild or temperate climates of the world; from these Guest Editor Wyman and his collaborators have selected about 300 species and varieties with flowers that are showy enough to be called -- with emphasis, flowering shrubs.

The spring-blooming witch-hazel starts the parade of flowering shrubs in late January and February, before the snow is off the ground; nine months later the common witch-hazel brings the parade to a close. A careful selection of some thirty shrubs from the sequence-of-bloom list (p. 50), will give the good gardener flowers every day of the eight months in between. Supplemented by appropriate evergreens and flowering trees, the opportunities for year-round beauty are only as limited as the skill and imagination of the gardener. This is a challenge for all of us.

A word about community beautification: whether town or city, flowering shrubs can mean the difference between drabness and charm. Not many years ago one of the Botanic Garden's good friends was instrumental in having Forsythia adopted as Brooklyn's official flower. Thousands of these cheery early-blooming shrubs are now to be found in the 80 square miles of this sprawling "greatest borough of New York City," and thousands more are planted each year. Why not an official flowering shrub or tree for your home town?

Yours sincerely,

George S. Avery, Jr.
Director

Reminders:

1. Title page and contents of the 1950 volume will soon be sent to libraries for binding; to individuals only upon request.
2. MEMBERS OF THE GARDEN: Save May 15-16 for the 1951 tour of Long Island Estates--announcement to come.
3. Save every issue of PLANTS & GARDENS. Quick-as-a-wink binders available at \$1.00 each.

← Willows in springtime at the Brooklyn Botanic Garden

Except where otherwise credited, photos by Louis Buhle



Photo courtesy of Arnold Arboretum

Chinese lilac (*Syringa chinensis*), the most floriferous of all the lilacs

LILACS

Common and otherwise

John C. Wister

THE common lilac (*Syringa vulgaris*) was taken from gardens in Constantinople to northern Europe in the sixteenth century. It probably reached this country sometime in the seventeenth century. Except for the extreme South, it can be grown in any part of this country and in most parts of Canada. It thrives in regions of cold winters and hot summers. While it prefers a lime soil, it will grow in neutral or slightly acid soil. Any plant so tolerant is bound to be widely grown.

The modern gardener grows many hardy shrubs unknown a generation ago,

but none of them have surpassed in popularity the common lilac. The flowers are so lovely and fragrant that few people object to the facts that the shrub is not particularly graceful when out of bloom and that it entirely lacks the beauty of autumn foliage color, or interest of fruit.

Variations in the Common Lilac

Variations of color, noticed by discerning nurserymen, have been put into commerce under variety names. At least four hundred of these are being grown in some of the great collections of the country. (The collections at the Arnold Arboretum, Jamaica Plain, Massachusetts, and at Highland Park, Rochester, New York, are the largest.) The flowers have a great color range, blue and pink

as well as deep purple and white. The flowers may be either single or double and have been selected also for length of season; particularly early or late varieties are especially valuable. There is also a considerable variation in growth: some are tall and leggy, others short and bushy; and so plants of desired habit may be selected. All of these factors combine to make the lilac widely grown.

Other Species

Gardeners also grow other species of lilac; but many of these differ so much from the common lilac that it is difficult for the ordinary gardener to realize that they are related to it. Most of these are new to our gardens; but some of them, like the Persian lilac (*Syringa persica*), have been with us almost as long as the common lilac.

The Persian lilac is a much more graceful shrub than the common lilac. Its foliage is more feathery, it is more shapely, and it makes a particularly fine hedge. The plant most commonly received if a "Persian lilac" is purchased from a nursery is not the true Persian lilac but a hybrid between it and the common lilac, produced nearly 200 years ago. This hybrid is called *Syringa chinensis*, although it originated in France. It is a sturdier grower than the true Persian species.

The common lilac is a native of the mountains of southern Europe, particularly of Hungary and Bulgaria, along with the Hungarian lilac (*Syringa josikaea*). Nearly all the other species are Chinese; even the Persian lilac is now considered to have been taken to Persian gardens from China many centuries ago.

The Hungarian lilac is typical of the general appearance of the Chinese lilac species. One of the best-known is the late lilac (*Syringa villosa*), a large, coarse-growing shrub suited to the coldest climates. Its flowers are a rather washy pale pink, later than the common lilac. Like most of its related Chinese species, it lacks almost entirely the fragrance of the common lilac, though it has a strong



McFarland photos

Branches of the hairy lilac
(*Syringa pubescens*)

smell reminiscent of that of California privet.

Syringa sweginzowii is a member of this Chinese group. Its flowers, while darker than those of the late lilac, are not particularly striking. The nodding lilac (*Syringa reflexa*) is the most unusual of the lilac species because the flower spikes droop gracefully. These three Chinese species, along with the European *S. josikaea*, are sufficient for the ordinary gardener and are about all that the general nurseries are likely to carry. Nurseries specializing in lilac species will have also *Syringa potanini*, *julianae*, *wolfi*, and the felty lilac (*S. tomentella*).

Not quite so late-blooming as the late lilac and much more like the Persian lilac is the hairy lilac (*Syringa pubescens*) of central China. It forms a sturdy and rather graceful bush 6 to 8 feet in height.

wide spreading, with small flower spikes on the ends of waving branches. Its fragrance is much liked by some people. Similar to this species are the little-leaf lilac (*S. microphylla*), and *S. meyeri* which is sometimes confused with it.

The tree lilac most commonly seen is the Japanese one (*Syringa amurensis japonica*). It forms a fine shade tree 40 feet or more in height with a strong upright trunk. Many people do not recognize it as a lilac when it is not in bloom. Late in June it bears great spikes of heavy, creamy white flowers with a strong smell of the flowers of privet. The bloom is very striking, high in the air all over the tree.

Hybrids

Plant breeders have been working for many years on lilacs. Among the most recent hybrids in the late-blooming group are those made by Miss Isabella Preston in Ottawa, Quebec, Canada. One group, the cross of *S. villosa* × *S. reflexa*, has been named *S. prestoniae* in her honor; among these is the type variety "Isabella." Other varieties include "Jessica," "Miranda," and "W. T. Macoun," the last named for Miss Preston's chief at the Experiment Station. The flowers of these hybrids are handsome and the plants grow remarkably well. It does not seem strange that these are surpassing in popularity the older group.

Another group of late hybrids is a cross between *S. josikaea* and *S. reflexa*—called *S. josiflexa*. "Guinevere" is the type variety. A German breeder, H. A. Hesse, has recently produced an excellent cross of *S. sveginzovi* × *S. reflexa*, which he calls *S. svegiflexa*.

Half a century ago Professor Louis Henry, Director of the Paris Museum of Natural History, produced a number of plants which are known as *S. henryi*. The type variety of this cross is "Lutece," which Professor Sargent of the Arnold Arboretum considered the finest of the late lilacs. Lemoine crossed this with *S. sveginzovi*, producing a race named in honor of his native city, *S. nanceianus*.

Varieties included in this group are "Floreal" and "Rutilant." They make great coarse bushes 15 or more feet in height and width. The foliage is attractive, and the flowers (on the pinkish side of lilac) are borne in profusion.

The early lilac (*Syringa oblata*), in China, superficially resembles the common lilac. Several of its forms have been brought into cultivation, where they have proved to be earlier-blooming than the common lilac. Lemoine made crosses with one variety, the purple early lilac (*S. oblata giraldi*), and in 1911 introduced a new race of early-blooming hybrid lilacs which are of the greatest value to our gardens. They have great vigor; in five or ten years they grow almost twice as tall and broad as a common lilac would in the same time. They bloom from a week to ten days before the common lilac and have its beauty and fragrance. They have more open spikes and a very limited color range, on the pinkish side of lilac. Their growth is so quick that it tends to be a fault. Some of them get very leggy and require constant and severe pruning. These early hybrids, therefore, should not be used in a city garden; but where there is plenty of space they are truly magnificent.

Among the varieties of this race are "Lamartine," "Catinat," "Louvois," "Montesquieu," and "Necker." Most of them have single flowers. The few with double flowers are not particularly attractive.

In 1917 the great explorer E. H. Wilson brought from Korea the Korean early lilac (*Syringa oblata dilatata*). It was even earlier-blooming than var. *giraldi* and it grew broad and flat-topped. The new hybrids were strong-growing, yet did not tend to become leggy. The first cross with this variety was made by Mr. F. L. Skinner of Dropmore, Manitoba, Canada; he introduced in 1936 the varieties "Assessippi," "Excel," "Evangeline," "Minnehaha," and "Pocahontas." The first of these, "Assessippi," is one of the most beautiful of all lilacs; it has a fine, broad-topped habit and is literally cov-

Flower clusters of
"Marechal Lannes,"
one of the well-known
older varieties,
violet-colored



ered each year with wonderfully fragrant flowers close to the common lilac in color. The variety "Pocahontas" was the first to have a really deep color. In the North it is said to be as deep purple as Ludwig Spaeth. At Swarthmore, Pennsylvania, it opens a deep purple but if the weather is hot it quickly fades much paler. By the use of Lemoine's early hybrids and of *Syringa oblata dilatata* and its hybrids the gardener may have an extra ten days or two weeks of bloom before the common lilacs open. Mr. Skinner reports that both single and double white varieties and blue varieties are appearing in this group, but some of them may not be so early as those of lilac-pink shades. All have good foliage free from mildew—

another quality greatly to be desired. *S. oblata dilatata* itself can easily be distinguished by the bronze color of its foliage in the early spring and again in the autumn.

I have tried to make it clear that there are many lilacs other than the common one which deserve attention. I still prefer the fine new varieties of French lilacs, so called because most of their breeding was done by V. Lemoine and his son Emil of Nancy, France. Working for nearly seventy years, they dominated the lilac world in the production of interesting forms. Out of a hundred most popular lilacs chosen by a group of lilac fanciers and published in the survey of the American Association of Botanical Gardens and

Arboretums, seventy-nine were introduced by Lemoine.

Varieties

The varieties originated in the last part of the nineteenth century and the first twenty years of this century are getting well known. It seems strange, however, that those introduced during the last twenty years are not widely planted and are difficult to find in nurseries in this country. I hope that readers of *PLANTS & GARDENS* will ask their nurserymen for these, as it is only through such amateur demand that the modern nursery will take the risk of propagating new plants. The Lilac Survey, already mentioned, published lists of fine varieties. The older ones of these are well known. They include the single whites, "Vestale," "Mont Blanc," "Mme. Florent Stepman"; the double whites, "Mme. Lemoine," "Jeanne d'Arc," "Edith Cavell," and "Ellen Willmott"; the violet-colored "De Miribel," "Cavour," "Marechal Lannes," "Violetta"; the blues, "Pres. Lincoln," "Decaisne," "Olivier de Serres," "Maurice Barres," "Pres. Grevy," "Pres. Viger," and "Rene Jarry Desloges."

Among those in the pinkish tones are the well-known "Belle de Nancy," "Katherine Havemeyer," "Waldeck Rousseau," "Mme. Buchner," "Virginite," "Lucie Baltet," and "Macrostachya." In magenta or red-purple colors are the famous varieties "Mme. F. Morel," "Reaumur," "Congo," and the very old "Charles X"; and in double, "Paul Thirion," "Georges Bellair." In deep purple we have several magnificent varieties such as "Ludwig Spaeth," "Monge," and "Toussaint Louverture."

All of these were originated before 1920. The novelties of the last thirty years include such fine whites as "Marie Finon" and "Candeur"; blues, such as "Fraicheur" and "Diplomate"; pinkish magenta, such as "Marechal Foch," "Capitaine Baltet," and "Prodige," and the double variety "Capitaine Perrault."

Our gardens have also been enriched by American breeders such as John Dun-

bar of Highland Park, Rochester, New York, who introduced the bluest of all our single blues, "President Lincoln." Following him came Theodore Havemeyer, president of the Horticultural Society of New York, who introduced such fine varieties as "Mrs. Marshall," "Night," "Glory," "Priscilla," "Charm," and "Dusk." More recent is W. B. Clarke of San Jose, California, who has just introduced "Clarke's Giant," "Esther Staley," "Pink Spray," and others.

Soil

The mere fact that lilacs grow well with a minimum of care does not mean they should be neglected; for best results the soil should be well prepared and have plenty of plant food incorporated into it. All lilacs benefit from a mulch of animal manure, or (where this is not available) leaf mold or peat into which have been incorporated lime and either a complete fertilizer or plant foods such as raw rock phosphate or superphosphate, bone meal, wood ashes, and some nitrogen, preferably in organic form as in cotton seed meal.

Pruning

The Chinese species and their late hybrids need very little pruning—only enough to take out stems which grow too thickly in the center of the plant. The early hybrids and the French lilacs, however, are benefitted by regular pruning. The best time to do this is after the blooming period in May. It can be done in the winter, but then a certain amount of bloom of that year has to be sacrificed.

The best pruning for lilacs involves the training of the whole bush. Some people train it to a single stem. That is not desirable in places where there are apt to be infestations from lilac borer; for if the borer takes the only stem, the plant is killed. For this reason many growers keep the plant broad at the base, with six to a dozen main stems—each year thinning the suckers and cutting out two or three of the oldest and tallest stems. This permits the younger stems to mature their growth and bear the



"Vestale," a single white lilac with heavy clusters of flowers

greatest number of flowers, and keeps the plant a reasonable size.

After the blooming period it is well to cut out cross branches and branches which head into the center of the plant. The most careful growers cut off the dead flowers, for the development of seed is presumably a drain on the plant and hinders the formation of great numbers of flower buds for the next year. It is not necessary to remove the dead flowers, for it is never done in nature; but the appearance of the bush is better after the unsightly fading flowers are taken off.

Propagation

Few people care to ripen the seeds and plant them. The chance of getting a variety even as good as the one from which the seed was taken is very remote:

the fine varieties of today have been selected by expert growers from many, many thousands of seedlings. But it is an interesting hobby to grow a few from seed and watch for possible improvements.

The amateur can best propagate the common lilae by taking off young suckers a foot or two high, putting them in a special place for a few years, and then putting them in a permanent position. More skilled amateurs can grow lilae from softwood cuttings in June, but this requires very careful observation of the condition of the wood in order to take it when it is exactly ripe enough. Wood taken too soon is too soft and quickly decays; if taken too late the wood is so hard that it does not root.

There has been great condemnation of the commercial practice of grafting lilae



Richard Averill Smith photos; Mary Deputy Lamson, L. A.

A row of lilacs effectively screens property from roadway

on privet. Fine plants can be so grown if the grafts are placed so deep in the ground that they can form their own roots the first or second year. The small percentage that do not form their own roots are but short-lived.

Pests

Lilacs are subject to scale insects, but these are easily controlled by dormant sprays of lime sulfur or miscible oil; the latter is easier and more pleasant to apply. In most collections spraying is necessary only every third or fourth year, or even less often. Many people keep

their lilacs clean without spraying by watching for an infested branch, cutting it off, and burning it.

Far more difficult to combat is the lilac borer. It can be found from tell-tale heaps of sawdust on the ground under the stems in May or June. The old-fashioned methods of cutting the hole open or putting down a wire to impale the borer often did as much harm as the borer did. The modern way is to use one of the commercial preparations which can be injected into the hole from a small, soft metal tube. The same results can be had by using the less pleasant carbon bisulfide.



Lilacs (at right) harmoniously used, add charm to a garden

Most of the borer damage is done fairly near the ground on the older stems, and it is often easier to cut out the infested stem than to look for each borer. The leopard moth larva, which bores into the younger stems, is more difficult to detect. In dry years one of the carpenter wasps is likely to girdle the stems; this injury is not noticed until the next spring when those stems do not send out leaves. Some new methods for combatting this insect are repellent sprays and others are poisons like DDT. These newer poisons should be used with great caution. They often kill off the parasites of some of our

insect pests and so do more harm than good. Also, their accumulative effect upon the plant and upon the soil is not fully understood.

Untold thousands of gardeners are growing lilacs successfully without any such careful procedure as I have described. The plants are vigorous and will succeed if given any fair chance. It is difficult to think of any other shrub so tolerant of many conditions and so well repaying the gardener for the little care he may give them, by their wonderful season of fragrant and beautiful flowers.



McFarland

The sweet-scented Mayflower viburnum (*V. carlesii*) is pleasing to all who view or cross this rustic bridge

VIBURNUMS

Versatile and justly popular

Robert B. Clark

FEW groups of woody plants offer so much variety and year-round attractiveness as do the viburnums. Interesting variations in size, form, and flowering and fruiting habits are a few of their attractive qualities. Their actual relationships are often obscured because not every one of them is known as some kind of viburnum; instead they are called arrow-wood, black-haw, dockmackie, hobble-bush, withe-rod, and so on. All are viburnums, however, possessing in common such characteristics as opposite leaves, flattened seeds, and tiny flowers clustered into heads.

The viburnums rightfully occupy a position of esteem among garden lovers. It is almost safe to say that whenever the use of a shrub is contemplated, a viburnum could be wisely chosen. To be sure, the amount of space available is frequently a limiting factor: viburnums range up to 30 feet in height. Some have tender flower buds, but many of them are absolutely dependable in severe climatic conditions. Besides beautiful flowers, the viburnums bring to the garden colorful fruit, and foliage of interesting texture.

Most viburnums are shrubs with upright, spreading, or arching branches. They are clothed with attractive foliage during the growing season and are often noteworthy at other times of the year. The flowers virtually cover the plant and

are usually borne in rather large heads, 2 to 4½ inches across. The berries develop in clusters and are red, yellow, or blue-black when ripe. Depending upon the species, the period of greatest attractiveness of fruit varies from midsummer to midwinter. Even wintertime among viburnums is not a dreary season; the branching habits are interesting and the buds exceedingly decorative.

Fragrant Kinds

Toward the latter part of April, when few woody plants have begun to show signs of activity, a most delightful fragrance is noticed if a Mayflower viburnum (*Viburnum carlesii*) is growing near by. The flowers, though beautiful, are easily overlooked amid the dull green unfolding leaves, yet the perfume quickly betrays the shrub's presence. It is often grafted on *V. lantana*. It is compact, with interlacing branches which seldom exceed the height of the observer's eye. Since it is most conspicuous in the early spring, such a species should only be planted as a filler in the border where its decidedly neutral foliage blends well with other shrubs.

The Burkwood viburnum (*V. burkwoodii*), a hybrid of the preceding species with service viburnum (*V. utile*), resembles *V. carlesii* except for its greater openness and uncertain adaptability in northern gardens; it is more vigorous and equally sweet-scented. (See illustration in color section.) Another closely allied species is fragrant viburnum (*V. fragrans*), of narrow and erect stature, with the disappointing trait of frequently failing to bloom unless the northern winter has been a mild one. The plant itself survives, but the flower buds are often killed. When they do appear, however, the flowers are pink in the bud stage; and the clusters are considerably smaller in size yet scarcely less fragrant than the Mayflower viburnum already mentioned.

The preceding sorts, without exception, are pleasantly perfumed. As much cannot be promised for certain other species



Roche photo

Clusters of flowers of the
Mayflower viburnum

of this large group, for some are decidedly ill-smelling.

Most tree-like is the Siebold viburnum (*V. sieboldii*), which sometimes attains heights of 20 to 30 feet. It is bold and coarse in foliage texture; the leaves are dark green and glossy. Certainly the strongest-scented of the viburnums, the flowers are repulsive to many persons. Despite its several excellent features, therefore, it should be planted in situations where its objectionable fragrance is not readily noticed.

Showy Marginal Flowers

Certain species of viburnum have flower clusters bordered by a row of showy sterile florets. Such sorts are favored by discriminating gardeners for their striking floral display. One of the choicest of this group is the hobble-bush

(*Viburnum alnifolium*), which is not widely cultivated because of its preference for cool, shady situations where moisture is present. Rosettes of white flowers may be seen in late May arising at virtually every joint. By early September these flowers have developed into clusters of brightest red fruits, which contrast exquisitely with the large, dark green leaves. In nature this plant forms an impenetrable hobble or barrier, which accounts for its common name.

The double-file viburnum (*V. tomentosum*) is a sight to behold in mid-May, with its twin rows of flowers along the horizontal branches. A lace-like pattern of the sterile white florets makes an exquisite contrast with the dark green foliage. In midsummer the stalks bearing the blue-black fruits are bright red. Being rather difficult to transplant, this species should be planted only in small sizes and in locations where it may develop into the handsome specimen it is capable of becoming.

The European cranberry-bush (*Viburnum opulus*) blooms in mid-May, while the Sargent viburnum (*V. sargentii*) is in full flower during late May and early June. Both species have a ring of sterile florets around the flower cluster. They are very large shrubs with handsome three-lobed leaves. Their fruits resemble the cranberry in size and color, although there are varieties with equally attractive yellow fruits.

Snowballs

Two viburnums in the North have the snowball type of flower cluster. The florets are entirely sterile and form a large globular head. These are forms of two species already referred to. They are the Guelder-rose or European snowball (*Viburnum opulus roseum*), and the Japanese snowball (*V. tomentosum sterile*). They bloom about the same time—nearly the entire month of May. Here the resemblance ends. The Japanese is superior to the European snowball because it is not visited by aphids, which deform the branchlets into grotesque pat-

terns. Moreover, it is smaller in stature and more suitable for gardens of moderate size. Like the species itself, this snowball does not easily withstand transplanting and should be moved with care. Such forms, of course, do not have berries.

Common Type

The commonest type of flower cluster among the viburnums is the somewhat flattened head in which all flowers are capable of developing into berries. Such flower clusters are not unlike those of the familiar Queen Anne's lace. Their conspicuousness depends upon the aggregation of the numerous tiny flowers which form the cluster.

Species of this group include arrow-wood (*Viburnum dentatum*), linden viburnum (*V. dilatatum*), and the Wright viburnum (*V. wrightii*). The latter two have conspicuous red berries, while the berries of the arrow-wood are blue and less attractive. Each is a mass of white overlaying the fresh green foliage during the blooming season. The nanny-berry (*V. lentago*) is a large shrub with graceful arching branches. Where space is not a limiting factor, the nanny-berry is welcome for its fountain-like effect.

For several weeks in early spring the expanding flower buds of the black-haw (*Viburnum prunifolium*) are readily noticed. This small tree is adorned with sizable flower heads when grown in the open under optimum conditions. At first pale pink, the flowers soon become clear white. The branches are horizontal, spurred, and stiff, and afford excellent shelter for wild life. Tasty when ripe, the berries are first green, then pink, and finally blue-black—hence the name, black-haw, from the plant's supposed resemblance to the hawthorn.

Of upright branching habit, the tea viburnum (*V. setigerum*) is handsomest in autumn, when its scarlet berries are brilliant. These fruits are borne in rather large clusters and are very decorative. Another worth-while species is the native withe-rod (*V. cassinoides*), which is

Linden viburnum
(*V. dilatatum*)

McFarland photo



among the earliest of shrubs to take on autumn coloration—very slowly at first, with only a leaf or two showing delicate pink. The berries are equally interesting when ripening. Like black-haws, they are pale green and large until late summer; they then become pink, and soon blue. At maturity in October they are deep blue-black. This plant is not overpowering in height, and it prefers moist situations.

The maple-leaved viburnum or dockmackie (*V. acerifolium*) is at its best as a woodland shrub: it thrives despite shade. In open sunlight this plant attains greater height and more fullness of foliage than under a canopy of forest trees. The flowers are borne on the tips of the slender stems and develop into clusters of cadet-blue berries. In its autumn foliage, with subtle tapestry effects, this species is outstanding among viburnums.

Last of this large group to bloom is the downy viburnum (*V. pubescens*). It resembles the arrow-wood in many ways but is much later-flowering. Coming into bloom late in June, it extends the viburnum season to two full months from the first opening of the fragrant species.

Profusion of flowers is the usual characteristic of viburnums. Even though the predominating color is white, and the blooming season for the entire group barely extends beyond six or eight weeks of spring, the floral effect is that of luxuriance like the lilac and crab apple. Most viburnums produce fruit in opulence, which is an added attractiveness over and above the pleasingly textured foliage of summer. Several of the native species also display tapestry-like autumn foliage before revealing the interesting traceries of their slender branches of winter.



Roche photos

Flower clusters of the European cranberry-bush (*Viburnum opulus*)—in May



Clusters of brilliant red fruits on the same plant in the autumn



Roche photo

The yellow ribbon-like petals of Chinese witch-hazel (*Hamamelis mollis*) do more than their share to enliven the winter garden

SHRUBS OF INTEREST DURING TWO SEASONS OF THE YEAR

Especially for small gardens

Donald Wyman

GARDENERS in the northern part of the United States have at least a thousand different kinds of shrubs which can be used in landscape planting; and of course in the deep South the number is even greater. However, many of these shrubs are of interest only at one season of the year. Take the lilacs, or the deutzias, or the forsythias—these are all plants that are very beautiful in flower, but they have no interesting fruits nor autumn color. Hence they are used in gardens chiefly for their spring bloom.

With strong emphasis being placed on small gardens these days, there is a great demand for certain types of shrubs that

have a longer period of ornamental beauty than the two weeks or less they are in flower. These shrubs (and there are many) are the ones which should be used as the accent points in large gardens; and certainly they should be given preference for consideration in the small gardens, where, to earn a place in the confined area available, every shrub should have some ornamental asset in addition to interesting flowers.

Evergreen or Colored Foliage or Colored Stems

There are some that have evergreen foliage; others which have colored foliage that is of interest throughout the entire growing season. Such would be the red-leaved form of the Japanese maple (*Acer palmatum atropurpureum*) which is hardy

as far north as Boston or the purple-leaved form of the smoke-bush (*Cotinus coggygia purpureus*). The evergreens of course would be of value for a longer period; the yews, the mountain-laurel, and rhododendrons are a few. Then there is the evergreen bittersweet (*Eunonymus fortunei vegeta*) which is semi-evergreen in New England and evergreen farther south—an excellent plant not only because of its low shrubby or even vine-like character, and its evergreen foliage, but also because of its brilliant orange to red fruits in the fall. No other euonymus is so colorful as this one, year in and year out.

The brooms (*Cytisus* species) are of interest because of their bright yellow or purple flowers in the spring and also because of their green stems that are conspicuously colorful throughout the entire year. The leaves on some of these species are minute, sometimes difficult to see; but the plants look perfectly green the entire year if observed from a few feet away, because of the very green twigs. The Warminster broom (*C. praecox*) and the now naturalized Scotch broom (*C. scoparius*) are two species that can be used over a wide area in this country. It is well to know that they do best if transplanted directly from pots into their permanent growing place. Poor sandy soils seem to be best suited to their tastes.

Some of the evergreen barberries like the warty barberry (*Berberis verruculosa*) or the three-spine barberry (*B. triacanthophora*) have merit, for their evergreen foliage is always present, and their diminutive yellow flowers in the spring, followed by their blue-black fruits later, add considerably to their value. Of course, the Oregon holly-grape should be included in this list, for its glossy evergreen leaves turn a good bronze in the fall, and the yellow flowers, in spikes, are most prominent in early May. The bluish black, grape-like fruits appear in the summer to give additional color to this native from the Pacific Northwest.

The drooping leucothoe (*Leucothoe catesbaei*) is another native that might

well be included in this group. Although it may grow 6 feet tall, it is usually seen much smaller than this. Its arching, evergreen branches are densely borne, and the small, waxy flowers are pendulous on the underside of these branches, appearing in early June. Its autumn color is a good bronze, especially when it is grown in the full sun.

The Japanese andromeda (*Pieris japonica*) and its very near relative the mountain andromeda (*P. floribunda*) are two more worthy flowering evergreens, the former not quite so hardy as the latter, but with considerably glossier foliage. Their white flowers appear in small pyramidal spikes in the early spring, and they both serve very well indeed in foundation plantings.

Flowers and Autumn Foliage

Some flowering shrubs, like the glossy abelia (*Abelia grandiflora*), the *Enkianthus* species, *Fothergilla* species, witch-hazels (*Hamamelis*), the royal azalea (*Rhododendron schlippenbachii*), the pink-shell azalea (*R. vaseyi*) and the bridal-wreath (*Spiraea prunifolia plena*) are of value because of their flowers and their brilliant autumn foliage coloration. All these mentioned are at the top of any list for colorful fall beauty. The *Enkianthus*, azaleas, and the spirea are red to scarlet, the witch-hazels are yellow, and the fothergillas are a gorgeous combination of red and yellow. Incidentally, these fothergillas, natives of the southeastern United States, are among the best of all our native flowering shrubs. Akin to the witch-hazels, they have small thimble-like white flowers in midspring, and practically no insect or disease pests. It is too bad that more nurserymen do not propagate them, for they could easily be used over nearly half of the United States.

The star magnolia (*Magnolia stellata*) might also be considered in this group of flowering shrubs with interesting autumn color. It is the hardiest of the magnolias, and though eventually a tree, it grows with many leaders and can easily be considered as a shrub for the first thirty



Photos courtesy of Arnold Arboretum

A cotoneaster (*C. multiflora*), with showy white flowers which are followed by red fruits

years of its life at least. Its pure white flowers appear very early in the spring, before the leaves, and have at least a dozen petals. They are often 4 inches or more across and are fragrant. The narrow leaves, about 6 inches long, are a fine dark green throughout the summer and turn a rich bronze in the fall, especially if the plants are grown in the full sun. The star magnolia makes a truly dense shrubby mass of foliage, is not nearly so susceptible to magnolia scale as are the other magnolias, and has much merit as a specimen plant.

Flowers and Form

A few of the mock-oranges might be mentioned because of their good flowers as well as their form. Many of them have foliage that turns a golden yellow in the fall; and of course all of them have profusely borne white flowers, some of which are fragrant. The beadle mock-orange

(*Philadelphus floridus*) and its near relative *P. splendens*, are both about 8 feet tall and clothed with branches completely to the base—making them flowering shrubs that can be used in conspicuous places. Many of the mock-oranges are bare of branches at the base, so that they can be used only at the rear of the shrub border. The drooping mock-orange (*P. larus*) is only 6 feet tall but has the same general characteristics of shape as the other two. The Lemoine variety "Avalanche" is only 4 feet tall but has arching branches touching the ground on all sides.

Flowers and Fruits

Many gardeners and professional horticulturists alike, believe that the best of the flowering shrubs should be those that have interesting fruits as well as good flowers. There are certainly some very choice shrubs to be considered in this group. In fact, some that are included



Warminster broom (*Cytisus praecox*), with bright yellow flowers in May and green stems of year-round interest

in the following paragraphs have an added attraction in the autumn color of their foliage. Such worthy plants should always be considered for planting in restricted places, since they are easily among the very best.

Some of the shrubby dogwoods like the Siberian dogwood and the Cornelian-cherry (*Cornus mas*) have profuse small flowers in the spring followed by colorful fruits in the late summer.

The cotoneasters as a group are not especially outstanding in flower, for the flowers are very small, but those of the rock spray (*C. horizontalis*) are slightly pink and so delicately borne on the upper side of the branches that this species should bear mentioning; the fruits following are bright red and remain on a good part of the winter. Another species, *C. multiflora*, has its flowers borne in tight umbels, and a 6-foot shrub of this species in full flower is very beautiful.

The fruits again make this plant important as an ornamental when they turn a pink to red color in the early fall.

The beauty-bush (*Kolkwitzia amabilis*) might also be mentioned. It is well known with its light pink flowers in early June, but these are followed by fuzzy brown fruits that remain conspicuous on the plants for weeks later, even until late fall. This species is also one of the small group of flowering shrubs which is not infested with any serious insect or disease pests and so needs little care.

The lowly Regel privet is usually used in clipped hedges—but have you ever seen a long line of these horizontally branched shrubs in flower with their little tufts of white flowers at the end of almost every lateral branch? Or their myriads of small bluish berries in the fall and winter?

And the bush honeysuckles—these are the shrubs that are literally covered with



McFarland photo

Siebold viburnum (*V. sieboldi*), often considered the best of all viburnums for ornamental use

small, often fragrant flowers in mid-spring, and have the fleshy red and yellow berries later that are so bright and attractive to the birds. The Arnold, belle, blue-leaf, and Tatarian honeysuckles are all in this group. Particular mention should be made of the tall Amur honeysuckle (*Lonicera maackii*) which grows as high as 15 feet and bears fragrant white to yellowish flowers in mid-May and dark red berries from September to November. This is the honeysuckle that retains its leaves and its red fruits until Thanksgiving in most years—the last of the honeysuckles for colorful fall interest.

There are many of the species roses that easily come within this group of plants of interest for more than one season. Two common examples would be the Japanese rose (*Rosa multiflora*) and the rugosa rose, or the "sea tomato" as it is called in Japan. Both have excellent spring or summer flowers, and bright colored fruits in the fall. The latter has in addition, a conspicuous red and yellow foliage color in the fall which adds considerably to its usefulness. Even the highbush blueberry might be mentioned too, for its interesting flowers, blue fruits in the late summer, and brilliant scarlet autumn color.

Last, but very definitely not least, are the viburnums. These are thought of chiefly as fruiting shrubs, although the snowballs and *Viburnum carlesii* are used only for their flowers. However, some of these species make excellent two-season shrubs. Take for instance the native withe-rod (*V. cassinoides*), or the nannyberry (*V. lentago*), or the magnificent black-haw (*V. prunifolium*) and its southern counterpart the southern black-haw (*V. rufidulum*). These are all annually covered with profuse clusters of small white flowers in the spring, and their fruits color brilliantly in the fall. In fact, they go through an interesting color change, turning from green to yellow to pink to blue in such a way that often fruits of each one of those colors will appear in the same fruit cluster at

the same time. The autumn color of their foliage is a rich russet.

The European cranberry-bush (*V. opulus*) and its American relative the American cranberry-bush (*V. trilobum*), as well as the Sargent viburnum, have two kinds of flowers in the same cluster. The center is made up of very small flowers, surrounded by a ring of large sterile flowers setting off the whole cluster with a pronounced border. The fruits are fleshy and bright red, remaining on the plants far into the fall and early winter. The fruits of the American species are more edible than those of the European cranberry-bush, and early settlers used them for making preserves.

Lastly, three more viburnums very definitely should be included. Siebold viburnum might easily be considered the best of all the viburnums for ornamental usefulness. Its flower clusters are white and large; its fruits mature to a black color but prior to maturity are a bright red for several weeks in the early summer; and the red fruit stalks remain on the plant to lend it color for some time after the fruits have fallen. The excellent dark green foliage is one of its best assets, beautiful throughout the entire growing season.

The linden viburnum (*V. dilatatum*) is much lower (seldom over 9 feet in height and often less); it is covered with white flower clusters and later brilliant red fruit clusters about 5 inches across. Maries double-file viburnum (*V. tomentosum mariesii*) also is admired for its flowers and its red and black fruits as well as its interesting horizontal habit of branching.

These, then, are some of the best of the flowering shrubs, best from the standpoint of being colorfully serviceable for more than one season of the year. Individual likes and dislikes always play a very important part in the selection of the shrubs to go about the home grounds, but these plants should very definitely be given first consideration in every small planting where ornamental interest is desired for more than one season.



PRUNING RHODODENDRONS

The mere fact that rhododendrons are broad-leaved evergreens does not mean that they cannot be pruned like other shrubs. Many people hesitate to prune them, however; and this often results in tall, lanky, ungainly specimens devoid of branches and foliage. We know that in the South, especially in the mountains of Virginia and the Carolinas where the native rhododendrons are frequently collected by the carload for northern markets, large areas are burned over merely to kill these plants to the ground and force them to come up vigorously with many branches from the base.

A few years ago the large collection of rhododendrons at the Arnold Arboretum was in a pretty bad condition after several dry summers. Something had to be done to bring the plants back into a healthy condition. They had never been pruned! Therefore, a series of experiments was started in order to determine when and how these plants could be pruned without serious injury. Two or three interesting points are worth noting as a result of these experiments.

In the first place, as would be expected,

the earlier in the spring the pruning is done, the more opportunity the plant has to form adventitious buds. Secondly, wherever it is possible, cuts should be made immediately above some of the leaves (or leaf buds or leaf scars) of that particular year's growth. Close examination will show that every year the rhododendron twig grows a certain length, but that the leaves are clustered near the end of the growth and not distributed evenly along the twig. Cut through the leaves, or the places where leaves were, and new buds will quickly form. Cut below the leaves, and the stem will usually die back to the previous year's growth.

Rhododendrons can be cut to the ground and expected to recover in at least 80 per cent of the cases. However, it is safer to do the pruning over a period of time rather than all at once, for in this way the plant is gradually renewed and need never be unsightly. So, rhododendrons will withstand a certain amount of pruning; and properly done at the right time, this treatment should result in vigorous and more beautiful plants.

SIBERIAN DOGWOOD

The Siberian dogwood (*Cornus alba sibirica*) is one of the best shrubby dogwoods that can be planted—provided that it is taken care of properly. Like many other shrubby members of this clan, the flowers are white and very small but are borne in rather large flat clusters. They make a considerable show when they are in full bloom, and so do the white to slightly blue berries which follow later.

The real value of this shrub is in its

bright red twigs, which are very evident all winter long. If the plant is allowed to become overgrown, this color is not very effective. On the other hand, if the plants are cut to the ground every few years, the stems will always be bright red. Stems three or four years old lose this brilliant color. So, to be at its best, this shrub (as well as its American counterpart, *Cornus stolonifera*) should be kept young and vigorous by heavy pruning.



McFarland photo

Forsythia, showiest of the early-flowering shrubs

SHRUBS WITH YELLOW FLOWERS

Not many shrubs have yellow flowers, and those that do should be carefully considered. The **Chinese witch-hazel** (*Hamamelis mollis*) (illustrated in color and on p. 18) is the earliest one to flower and is closely followed by the interesting but rare **winter-hazels** (*Corylopsis* species) and then the hardy **forsythia** clan. The vigorous forsythia group has several species and varieties, ranging in height from about a foot to the 9-foot varieties of *F. intermedia* (see illustration in color section).

Shortly after the forsythias comes the **golden currant** (*Ribes odoratum*), an old-fashioned favorite with very fragrant flowers. Unfortunately it acts as one of the hosts for the white pine blister rust, but it does no harm if there are no white

pinus within a thousand feet of it. Then comes the **kerria** (mid-May), with its double-flowered variety the **globe-flower**, both of them conspicuous, for no other plants in bloom at this time are yellow.

The **shrubby cinquefoil** (*Potentilla fruticosa*) opens its first flowers in late May and blooms most of the summer. It is at home from coast to coast. Finally the profusely flowered **St. Johnsworts** (*Hypericum*) bring forth their small yellow flowers for the greater part of the summer; there are at least eight worthy species of these little shrubs, ranging from ground covers—*H. calycinum* and *buckleyi*—to *H. hookerianum* which may grow 6 feet high. These interesting plants certainly bear consideration for summer bloom.



Roche photo

Flower clusters of rose daphne (*D. cneorum*), a low, sweet-scented, densely flowering shrub

A FEW OF THE DAPHNES

Low shrubs with fragrant flowers

Alys Sutcliffe

DAPHNES are an attractive group of small shrubby plants, of which about fifty kinds are known; but unfortunately very few are available in this country. Of the ten or twelve that are hardy as far north as New York, only eight or nine are cultivated in eastern North America, and these are grown mostly in botanical gardens and arboreetums. The only ones listed in catalogs are *Daphne cneorum* (with its varieties *alba* and *variegata*) and *Daphne mezereum*, and occasionally *Daphne blagayana* and *Daphne petraea*—as well as several tenderer species, such as *Daphne collina*, *laureola*, and *odora* (see illustration in color), which are not described here.

Most of the Daphnes are very sweet-scented. They grow best in a sunny place, but like a cool moist root run. The soil recommended is a mixture of good loam and either leaf mold or peat moss, with limestone added to the mixture.

The "garland-flower" or rose daphne (*Daphne cneorum*), native to Europe, is the best-known of the daphnes in this region. It is perfectly hardy, and has been known to spread so much in a garden that it has had to be removed. It absolutely refuses to grow in the city under any conditions—all of which have been tried here at the Brooklyn Botanic Garden. Given country air, all is well: it will thrive in apparently the poorest soil in the worst location. *Daphne cneorum* itself is perhaps one of the best-looking of the group, with neat, compact, evergreen foliage, and rosettes of rose-pink flowers. It is much used for forcing as a pot plant. Propagation is by layering or by cuttings. Two varieties of *Daphne cneorum* are sometimes listed in catalogs: *Daphne cneorum alba* and *variegata*.

The February daphne (*Daphne mezereum*), native to Europe and Asia, a small upright shrub, is quite hardy. It is not

evergreen; it blooms in very early spring, before the leaves appear, so that the branches are covered with a mass of lilac-pink flowers. At a time of the year when little is in bloom, its gay blossoms stand out. It has become naturalized in many English woods. The varieties *alba* (with white flowers), *plena* (with double white flowers), and *grandiflora* (with larger,



McFarland photos

February daphne (*D. mezereum*), with striking rosy purple flowers, good in the woodland garden



Daphne burkwoodi, a very hardy hybrid

bright purple flowers), are cultivated occasionally.

The lilac daphne (*Daphne genkwa*), native to China and Korea, is another kind that flowers very early before the leaves appear. The delicate lilac flowers (which, however, are not fragrant) appear at the ends of the branches in clusters, which give the little plant (usually not more than 2 feet tall) the appearance of a small lilac. Several plants of this daphne succeeded for a number of years outdoors at the Brooklyn Botanic Garden, suffering only occasional damage, until they were killed during a particularly unfavorable winter. Hardiness of this handsome shrub, therefore, is unfortunately not assured. It is readily propagated by cuttings of semisoft side shoots taken shortly after flowering. Since cutting-raised plants

flower in two to three years, this kind offers excellent possibilities for forcing in a cool greenhouse.

Daphne blagayana comes from the mountains of southeastern Europe. The growth is rather straggly, but the white flowers are very sweet-scented. The plant will form a trailing (evergreen) mat if rocks are placed over the stems, and the spaces filled with a soil mixture.

Daphne tangutica, a native of northwestern China, with glossy dark green leaves half an inch wide and just over an inch long, forms its buds in the fall. The flowers are white, and open in May. This daphne has proved hardy in Manitoba, in a sunny spot protected from cold winds. It likes a covering of snow, and it should be provided with a cover of some sort to protect it from cold drying winds.

Daphne giraldi, a native of north-western China, is not so attractive as the other daphnes. It has yellow flowers in June, when the leaves are out; but it has red berries later in the year; at that time it is very effective. This daphne and *Daphne tangutica* may be raised from seed, and begin to flower when they are 3 to 4 years old.

Daphne burkwoodi, a hybrid of *D. caucasica* and *cucurum*, is a very hardy, dense, spreading bush, 2 to 2½ feet tall, with bluish-white, fragrant flowers (in three to four years) in early spring. Even in the North (in eastern Canada) the dark green foliage is retained through most of the winter, a fact that renders this shrub particularly valuable. In the New York region *Daphne burkwoodi* is perfectly evergreen. It is readily propagated by cuttings taken in early summer.

Daphne alpina, a dwarf, native to the European Alps and Pyrenees, reaches a height of about 1½ feet, and resembles in appearance a stunted *Daphne mezereum*.

(Actually, however, it is more closely related to the Asiatic species *Daphne altaica* and *caucasica*.) Its white flowers, which appear in spring together with the leaves, are not very showy but have a pleasing vanilla-like fragrance. It is eminently suitable for rock garden planting, and is hardy as far north as eastern Canada.

Daphne petraea, native to a delimited region of the Tyrolean Alps, is a diminutive shrublet which reaches a height of only 6 to 7 inches, and is a much-prized treasure of rock garden connoisseurs. Unfortunately, it is not always easy to grow successfully, since it demands a deep cool root run in tight fissures of dolomite rock. However, it is perfectly hardy as far north as southeastern Canada if suitable conditions are provided. Its rosy pink flowers are delightfully fragrant. *Daphne petraea grandiflora* forms very dense tight cushions of dark green leaves, covered from June to August with comparatively large pink flowers. It is even rarer, though still more desirable.

DOUBLE FLOWERS

The flowers that remain colorful on the plant for the greater length of time are the double ones. It is always well to keep this in mind and select varieties with double flowers when bloom is desired for a maximum period. However, it is these same double-flowered varieties that usually fail to produce fruits; and this is sometimes an undesirable quality, especially in the small garden.

Some varieties of shrubs with conspicuous double flowers certainly are to be found among the **camellias**, **lilacs**, **Japanese quinces**, **mock-oranges**, **azaleas**, **rhododendrons**, **roses**, **tree peonies**, and **shrub-altheas**. Others are the **globe-**

flower (*Kerria japonica pleniflora*), **snowflake deutzia** (*Deutzia scabra candidissima*) and its first cousin "Pride of Rochester" (*D. scabra plena*), the **dwarf flowering almond** (*Prunus glandulosa albo-plena*), **flowering almond** (*Prunus triloba multiplex*), the **bridal-wreath spirea** (*Spiraea prunifolia plena*), and the **star magnolia** (*Magnolia stellata*) which does have some fruits even though its flowers are double. Naturally, there are many others, but these are a few shrubs with double flowers which remain effective longer than their single-flowered close relations.

OTHER ARTICLES ON FLOWERING SHRUBS IN PLANTS & GARDENS

The Heath Family. Spring, 1947.
Shrubs for Summer and Autumn Bloom,
by George Graves. 1947, page 71.
Buddleia, by John C. Wister. 1947, page
82.

Buddleias of 1947, by Paul Schmidt.
1947, page 83.
New American Lilacs, by F. L. Skinner.
1948, page 22.
Dwarf and low-growing or slow-growing
plants. Autumn, 1949.

THE FLOWERING QUINCES

Rugged individualists among woody plants

John L. Creech

GARDENERS who have experienced the sudden burst of color that the many varieties of flowering quinces display in the early springtime or have paused on a gray, winter day to note the occasional splashes of color appearing as the quinces "anticipate" the far-off spring, will agree that here is the rugged individualist among our woody plants. The habit is far from graceful but there is considerable appeal to the stout, naked and twiggy branches, quite in keeping with the brilliance of the flowers which hardly can be reconciled to a plant of lesser stature.

Value to the Gardener

Undoubtedly, the long flowering period (beginning in the Washington, D. C., area in early April and lasting until June) together with the occasional flower clusters at almost any other time of the year has been responsible for the interest in quinces here and in Europe for at least the past eighty years. There was a marked decline in the use of the quinces in ornamental plantings during the 1920's when the San Jose scale was prevalent. Since then, the introduction of new varieties from Europe and a decline in the scale difficulties has sparked the use of flowering quinces so that (except in the colder parts of the country) there is scarcely a nursery that does not have some varieties for sale. In the South, although the emphasis is on evergreen material, the quinces are widely grown and their leafless branches, at flowering time, are a striking contrast to the dense greenness of the camellias with which they flower. In the North, their habit of early flowering, and then giving a repeat

performance after the first flowers have been destroyed by frost is evidence of their value to the gardener. In addition, they make excellent floral arrangements, quite in keeping with the modern school. The branches are angled into picturesque shapes and the flowers, which last for many days, are enhanced by artificial light. Finally, the golden fruits, edible only in preserves, are fragrant and give off a pleasant, spicy odor when ripening indoors. They are extremely hard and last for several weeks when lying on the ground under the shrubs.

Regarding the use of the flowering quinces in the garden, their variation in habit must be considered. The flowering quince (*Chaenomeles lagenaria*), itself, is an upright, often spreading shrub which will reach 8 feet if not pruned. (See illustration in color section.) The Japanese quince (*C. japonica*) is a dwarf, compact plant that will not exceed 3 feet in height. The hybrid, *C. superba*, derived from the above species and intermediate between them, is not so widely known. The fourth member of the genus, *C. sinensis*, is a tree and is excluded from this discussion, which pertains only to the shrub types.

Requirements

The quince is a shrub for the sun and one that does best in plantings of its own kind or as single specimens, for they require considerable space and do not have the graceful, arching habit of the usual woody border plants, like *Philadelphus* or *Spiraea*. While there is no objection to complete exposure, a more solid flower display results when the planting can be made in a somewhat sheltered, sunny spot. It is also desirable to plant them on the higher parts of the garden where sun pockets are often found.

Not being difficult to grow, the quinces are good city plants and require only a



Roche photo

Branches of Japanese flowering quince (*Chaenomeles japonica*)

well-drained loam, fertilized in the early spring with a small handful of a shrub fertilizer, such as 10-6-4, to keep them blooming profusely. More difficulty may arise from the fact that they are usually grafted than from any other reason. Either quince or apple seedlings are used for stock. When quince seedlings are used it is sometimes quite difficult to identify shoots arising from the stock while those that arise from apple stock

are easily identified and removed. In addition to grafted material, one will find seedling quinces in some nurseries. Such material can be very interesting as a wide range of colors and a varying amount of doubleness can be obtained. It still is preferable, however, to purchase named, grafted varieties.

The quinces have always been good barrier plants; their dense thorny branches are ideal for this purpose. They can be

used singly to protect a gap in a fence or as complete hedges. Since they flower on the last year's wood, a pruning in June is all that is necessary to keep them within bounds and permit them to attain an informal appearance.

The flowering quince is not desirable to use in a foundation planting where anyone has a reason to go behind the planting as it will forever be an impediment. The Japanese quince, however, can be used in low doorway plantings and will create the same effect as *Cotonaster horizontalis* but in a more robust manner and with the added, bright, orange flowers.

Varieties

The flowers of the quince varieties have a wide color range, all are brilliant and more or less cupped with fifty or more golden anthers at the center so that they sometimes resemble miniature camellias. Like them, the quinces have no flower odor. The flower clusters may be loosely scattered along the old wood or gathered in such dense masses that the stem is entirely hidden. Some varieties are almost leafless at flowering, such as "Simonii," "Boule de Feu" and "Umbilicata"; others, such as "Sanguinea," "Moerloesi" and "Rosea Grandiflora," have their blooms softened by small, reddish flags of expanding leaves.

The gardener will find when looking over the possible selections that there is a rather long list of varieties. Therefore, rather than to describe varieties indiscriminately, the following have been selected as covering the color range of the quinces. All are hardy in the East, and have few apparent disease or insect problems. There has been no scale or fire-blight on the plants growing at Glenn Dale, Md. Where one is growing several varieties, they should be very carefully labeled as it will be difficult to retrace the identity of some.

C. lagenaria:

"Boule de Feu": Erect, up to 8 feet, twiggy habit and heavily armed, almost

leafless at flowering. Flowers, $\frac{7}{8}$ ", single, vermilion. A good hedge variety.

"Cardinalis": Upright, to 6 feet, spreading habit, heavy blunt thorns. Flowers, $1\frac{1}{2}$ ", single, scarlet.

"Moerloesi": Spreading and less vigorous than most varieties, 3 feet; flowers, 1", single, carmine, splashed with pink and white, borne loosely along the stems. A low hedge variety.

"Nivalis": Upright and spreading, 5 feet. Flowers, $1\frac{1}{2}$ ", single, white. This is the best white, having large flowers.

"Rosea Grandiflora": Upright and spreading, 6 feet. Flowers, $1\frac{1}{2}$ ", single, geranium lake. Flowers in tight clusters, fine for cutting as leaves are well advanced at flowering.

"Sanguinea": Upright, 5 feet, few thorns. Flowers, $\frac{7}{8}$ ", semidouble, crimson. Good color but the flower size detracts. The variety "Grenade" is similar.

"Simonii": Upright and spreading, 4 feet, heavily armed. Flowers, $1\frac{1}{2}$ ", semidouble, geranium lake. This is the deepest colored variety, very showy anthers of golden yellow. The variety "Crimson and Gold" is similar.

C. japonica:

"Pygmea": low growing and dense, 3 feet. Flowers, 1", single, orange. A good foundation plant, with bright clear flowers tightly clustered on the old wood.

C. japonica alpina:

Very low growing, 15", dense. Flowers, 1-2", single, orange. This is the lowest grower, differing only in habit from "Pygmea."

In addition to the above varieties which are mostly older European selections, a number of new varieties that originated with Mr. W. B. Clarke, in California are being grown at the Glenn Dale, Md., garden but it is too soon to know how they will perform for us in the East.

Winter Daphne (*D. odora*), a shrub for southern and Pacific coast gardens; the most fragrant of all the daphnes.



Flowering Quince (*Chaenomeles lagenaria*) thrives from Maine to British Columbia and southward; colors range from scarlet, orange-red and pink to white.





For fragrance, in the North, the new hybrid Burkwood Viburnum (*V. burkwoodi*) is replacing the older, less vigorous *Viburnum carlesii*



Leptospermum, or Tea-Tree, a large shrub of Australian ancestry well known in California gardens; this is *L. scoparium* variety "Ruby Glow."

Weigela "Bristol Ruby," a very popular hybrid of *W. florida* and the old-fashioned favorite "Eva Rathke," is one of the darkest reds of all weigelas—a hardy shrub for northern gardens.







From the Common Lilac (*Syringa vulgaris*) of colonial dooryards to its many modern varieties, lilacs are probably unsurpassed as America's favorite flowering shrubs. Except for the extreme South, they grow almost everywhere in the United States and in most parts of Canada.



Lemoine Deutzia (*D. lemoinei*)—a hardy shrub for gardens in the North.

Chinese Witch-hazel (*Hamamelis mollis*) a very hardy asset to the snow-covered late-winter garden.

Showy Border Forsythia (*F. intermedia spectabilis*) is the deepest yellow of all forsythias—hardy from Massachusetts southward.



Canary Bird Bush (*Crotalaria agatiflora*) from East Africa, is suited to California gardens.



Henry St. Johnswort (*Hypericum patulum henryi*) from China, one of the best of the garden hypericums—thrives in northern gardens.



Camellias came to southern gardens from China and Japan. "Debutante," a variety of *C. japonica*, is free-flowering and compact in habit—a favorite for garden or greenhouse. Flowers of *C. reticulata* (below) may be single, semi-double or double.



CAMELLIAS

Fine ornamentals for mild climates

H. Harold Hume

AT some undated time, in years long gone by, camellias of sorts were taken from their natural habitats and grown in gardens in Asia. Thus began the culture of the economic species, *Camellia oleifera* and common tea (*C. sinensis*), and the fine ornamentals, *Camellia japonica*, *C. sasanqua*, and *C. reticulata*. Europeans found the last three growing in pots in nursery gardens in seaport towns of China and Japan. These were taken to Europe in the days of sailing ships, and to America beginning about the year 1800. *C. cuspidata*, *C. hongkongensis*, *C. maliflora*, and *C. saluenensis* have been added, some of them very recently, making a total of at least nine species now growing in gardens and greenhouses of the United States.

From *Camellia japonica* the greatest number of varieties have been derived; they number several hundred, maybe as many as a thousand, listed in the nursery catalogs of the United States. *C. sasanqua* has furnished a much smaller number, about one hundred. Belonging to *C. reticulata* the number of varieties is much smaller.

Range for Outdoor Growing

Camellias are now grown in gardens mainly in an area extending from southeastern Virginia southward into Florida, thence around the Gulf Coast westward into Texas. On the Pacific Coast they are grown in California and northward to British Columbia. This does not mean they are satisfactory garden plants in all this great area; but here and there within the geographical limits of these parts of the United States they are grown in suitable locations.

Varieties belonging to the species *Camellia sasanqua* appear to be more win-

ter resistant than varieties belonging to either *C. japonica* or *C. reticulata*. Though also grown in gardens, *C. reticulata* is preeminently a greenhouse variety; and of course varieties belonging to all the species may be grown in greenhouses far outside those regions in which they can be grown in gardens. Greenhouses afford protection not only from low temperatures, but against winds, beating rains, and other climatic drawbacks, and make it possible to grow finer flowers than can be produced out of doors, even in southerly areas.



McFarland photos

Peak bloom on a robust plant of camellia
"Bessie McArthur"

Culture

Temperature, moisture, and shade.

Garden camellias do not belong to the tropics; neither are they cold-climate plants; rather they belong to the warm temperate zone. A certain amount of chilling in winter is necessary for their well-being. Plants in good condition are very cold resistant (though not their flowers), and temperatures well under 20°F. are not harmful provided the plants are dormant. Where winter temperatures in colder parts of the country are kept under control in greenhouses, a temperature of 40° to 45° is maintained during the night, and during the daylight hours the thermometer is allowed to rise about ten degrees higher. This range of temperatures is conducive to the development of good blossoms. At the same time high humidity is provided by wetting walks, beds, or ground surfaces and by syringing the plants. Partial shade is a further help in producing fine flowers and keeping foliage in rich, dark green color. In gardens, protection against rays of the morning sun in those sections where frost occurs at times, is most desirable.

Soil. Camellias may be grown satisfactorily in soils of different kinds, clay, sand, and loam, or mixtures of them. Certain requirements, however, must be met in all soils; they must either be present naturally or be provided. These necessities are an acid condition (pH 5 to 6.5), good drainage, and high organic content. Soil conditions may be changed at planting time in the immediate environment of the plants by using a prepared soil. This can be made with one-third good garden soil, one-third sharp, acid sand, and one-third peat or well rotted cow manure. To increase the plant food in this prepared soil, a quart of camellia fertilizer should be added to each wheelbarrowful of soil and thoroughly mixed. This same soil mixture will be found satisfactory for growing plants in pots or other containers.

Planting is done in gardens in the South for the most part during the months of November to March. In many sec-

tions it is advisable to give preference to the earlier part of this planting season because the weather in the spring is dry; it is a good thing to have the plants in the ground with their root systems established well in advance of that period.

In planting, care must be exercised to see that the plants are no deeper than they grew before; it is an excellent rule to bring their roots right up to the surface of the ground. Holes should be wider and deeper than are necessary merely to take the balls of earth surrounding the roots of the plants. These larger holes give space in which to put goodly quantities of the prepared soil. That which is put in the bottom of the hole should be well packed to prevent sinking of the plant after planting. Water should be used liberally at planting time. Water will pack soil more effectually than hands or feet; but all three—hands, feet, and water—must be used. After the plant is in place, a little ridge should be made around it, to form a basin that will hold water. Water must be given from time to time and the tops of the plants syringed or sprinkled.

A mulch is advisable. Almost any plant material that is available may be used, such as leaves, buckwheat hulls, peanut shells, sugar cane refuse (bagasse), and peat. A mulch is desirable at all times. It helps to keep the moisture supply and temperature uniform, provides plant food as it decays, and helps to keep the soil acid. All these are conditions that are good for the growing of camellias.

Fertilizing should receive attention, and there are specially prepared fertilizers on the markets for use in growing camellias. The use of well decayed farm fertilizers is also helpful in growing good plants. Fertilizer should be spread evenly and thinly around the plants; it is safer to use too little than too much. Fertilizer should be applied three or four weeks in advance of starting of growth in the spring, again in July. Some like to make a third application in the early autumn (September to October). It



Camellia "Snowdrift" in a southern garden



Flowers of
"Hinode-Gumo,"
an especially fine single
to semidouble camellia

must always be remembered that the price paid for good flowers in the winter is good care and attention in the summer.

Pests

All plants in which human beings are interested are subject to attacks of insects and disease; to this statement camellias are no exception. Their leaves are eaten and their juices extracted by insects. When insects put in an appearance they should receive attention because good flowers are dependent on good leaves and good growth in the plants. Insects are rather easily controlled, however. The most injurious of the scale insects are the Tea, Camellia, Peony, and Red Scales. They are more troublesome toward the southern limits of camellia culture than in cooler sections. Control

is secured by spraying with miscible oil ("Florida Volck" is commonly used), in the late spring when the new growth of twigs and leaves has hardened. At this time a strength of 1 to 100 is recommended, a second application can be made in late September, using a strength of 1 to 60. Coverage must be complete, and the underside of the foliage must receive careful attention. "Parathion" also has given excellent results and it has an additional advantage in not being injurious to tender growth. It should be prepared and used strictly according to directions on the package. "Pomogreen," a mixture of sulfur and lead arsenate, will help to control such chewing insects as beetles, caterpillars, and grasshoppers; and "Toxaphene" is also effective against them. Mites can be controlled with dusting sulfur; and nicotine sulfate can be used

Flowers of camellia
"Mine-no-yuki,"
free-blooming and
very showy



against aphids, sometimes troublesome on new growth.

Varieties

Quite obviously it is not possible, within the space available, to describe a large number of camellia varieties; only a few of the Japonica and Sasanqua groups can be mentioned, and these can be discussed only briefly. There is a wide variety of forms from single to complete double, in colors (variegated or self) ranging from pure white through carmine to deep red; and they reach their flowering peaks in the South at different times from September to March or April.

Here are a few varieties of Japonica, a list that (though made up of fine sorts) could be replaced by another of equal or nearly equal merit. There is plenty of room for personal preferences.

SIX EARLY-FLOWERING JAPONICAS

"Alba Plena," Double Imbricated, self white, 3 to 4 inches. Best in color, form, and season.

"Daikagura," Incomplete Double, variegated carmine and white, 4 to 5 inches. Has sported in several colors, self white to self carmine. Very early and most satisfactory.

"Debutante," Double Irregular, chromatic self carmine, 3 to 3½ inches. Very satisfactory (illustrated in color).

"Imperator" (French), Double Irregular, self Turkey red to rose-madder, large, 4 inches plus. Very early, continuing even into midseason.

"White Empress," Semidouble, self white, large, 5 inches or more. Especially fine.

"Yohei-haku" (September Morn), Semidouble, white, large. Very early.

SIX MIDSEASON JAPONICAS

"Adolphe Audusson," Semidouble to Incomplete Double, self Turkey red, 4 to 5 inches. Very dependable and satisfactory.

"Aunt Jetty," Double Irregular, self Turkey red, or variegated with white, 4 inches. "Gov. Mouton" is a form with more variegations.

"Coquetti," Complete Double, Imbricated, self Turkey, 3 to 4 inches.

"Incarnata" (Lady Hume's Blush), Double Imbricated, white suffused with pale pink, 2½ to 3 inches. Three forms of flowers may be produced on one plant. Very dependable.

"Preston Rose," Double Irregular, self carmine, 3 to 4 inches. Free-flowering and showy.

"Woodville Red," Double Irregular, self neyron rose, 4 inches and larger. A very striking flower.

SIX LATE-FLOWERING JAPONICAS

"Eleanor Hagood," Double Imbricated, chromatic self carmine-rose, lighter at center, 3 to 4 inches. Fine.

"Kenny," Incomplete Double, variegated white with carmine markings, 3 to 4 inches.

"Matsukasa," Incomplete Double, variegated camellia pink with white, 3 to 4 inches. Petaloids curved and set up at angle.

"Mrs. K. Sawada," Double Imbricated, white faintly flushed light carmine, 3 to 4 inches. Very fine.

"Rev. John Bennett," Semidouble, self neyron rose with dark veins, central petaloids faintly washed white, 4 to 5 inches.

"Hishi-karaita," Incomplete Double, tyrian rose with deeper veins, center with white petaloids, 3 inches.

Camellias of the *Sasanqua* group (as represented in the United States) are early-flowering, beginning usually in September and finishing before the end of December in the South. They are especially desirable because flowers of

other kinds are not abundant in southern gardens during that period. Most varieties are single, but there are a few double or nearly double sorts, very satisfactory plants for hedges, for specimens, and for other garden uses. Their foliage is relatively small and bright glossy green.

SIX SASANQUAS

"Cleopatra," Semidouble, often with a double center, chromatic self rose-bengal, 2½ to 3 inches. A compact, vigorous grower, free-flowering.

"Hinode-gumo," Single to Semidouble, white at center, flushed and margined rose-bengal at edges, 3 to 4 inches. Plant openly branched. Especially fine.

"Mine-no-yuki," Incomplete Double, self white, 2½ to 3 inches. Free-flowering, open spreading or vase form. Very showy when in full flower.

"Papaver," Single, self solferino purple, creped, 3 inches. Compact, upright with slender branches.

"Showa-no-sakae," Double Irregular, chromatic self rhodamine-pink with lighter color toward bases of petaloids, 2½ to 3 inches. Growth spreading.

"Texas Star," Single, chromatic rhodamine pink, small, 2 to 2½ inches. Plant strict, upright and narrow in growth, an unusual form.

For many years *Camellia reticulata* was represented only by the type of the species (see illustration in color). Then George Forrest found this species growing wild in Yunnan, secured seeds, and sent them to England; it is now represented by very considerable numbers grown from Forrest's seeds and from seeds produced in England. Some horticultural varieties have been selected and named, and some of them have come to America. More recently Dr. W. E. Lammers and Mr. Ralph S. Peer have secured from Kunming, Yunnan, China, a number of fine varieties belonging to *C. reticulata*. These are in process of propagation and will be available within a few years.



McFarland photo

One of the few shrubs with showy, late-summer flowers—

ROSE-OF-SHARON

The shrub-althea or rose-of-Sharon (*Hibiscus syriacus*) is a common garden shrub used in many, many gardens. It is practically free of insects and diseases and blooms in the late summer at a time when few other woody plants have flowers. There are at least fifty named varieties available from commercial sources in America today, but many of these are very much alike. They grow up to 12 feet tall.

This shrub seems to be difficult to start properly as a young plant, even difficult to transplant at times. Once this hurdle is passed, it does well with practically no attention whatsoever. In order to force the production of good blossoms, some adopt the practice of heavily pruning the

previous year's growth in the spring, actually cutting back the elongation to two to four buds. This makes a rather too conspicuous plant, but it does result in profuse bloom. Without such pruning, the flowers will be profuse but small.

The flowers are single or double, depending on variety, and 2 to 4 inches in diameter. In color they may be pure white ("Snowdrift," single, or "Admiral Dewey," double), pink ("Rubis," single, or "Amplissimus," double), or blue or violet ("Coelestis," single, or "Ardens," double), with some varieties like "Anemonaeflorus," "Hamabo," and "Monstrosus" several colors. Reliable shrubs for late summer bloom, they have little to offer at other times of the year.

SHRUBS FOR DRY SOILS

Proper kinds and precautions

A. C. Hildreth

THE northwestern part of the Great Plains is a region of cold winters and scant and irregular precipitation. Long periods of low soil moisture make this area better suited to short grasses than to woody plants. Under irrigation it is possible to grow many shrubs common in humid climates at similar latitudes. However, experiments and experience have proved that ornamental shrubs can be grown in these periodically dry soils without irrigation provided certain precautions are taken and proper species are planted. Some of these dry-land species and cultural practices may be of value also for dry sites in regions of normally heavy rainfall.

Increasing and Conserving Soil Moisture

The first essential for dry-land culture is to employ all practical means of increasing and conserving the soil moisture immediately around the shrubs. Often additional water may be had by diverting into the shrub border the run-off from sod land, road ditches, or melting snow drifts. Water conservation practices in shrub plantings include terracing to prevent run-off; tillage to give a rough surface that absorbs rather than sheds rain; and, most important of all, clean cultivation to eliminate competing grass and weeds that otherwise would quickly sap the limited soil moisture. In dry soil shrubs should be wide apart in order to provide room in which the roots can range for water.

Species selected for landscaping on dry soils must be able not only to survive long droughts but also to maintain an attractive appearance during dry periods. Arid-climate shrubs have various adaptations that enable them to live in dry soils.

Among these are leafless stems of such plants as cactus and ephedra, that reduce water loss to a minimum; water-storage structures of succulents as in cacti; protective habits that bring the plant into balance with its water supply such as temporary wilting of foliage, shedding of leaves as in the ocotillo, or killing back of part of the top; and the ability to enter a dormant condition wherein the plant tissues endure extreme dessication without injury. Such adaptations are of great importance in maintaining vegetation in arid climates. They are, however, of little horticultural value because they do not make for attractive shrubs. Wilted foliage or leafless, dessicated stems are not what gardeners want in shrub borders. Although flowers of desert shrubs as cacti, ocotillos, and yuccas are beautiful and striking landscape effects are sometimes produced with these bizarre plant types, they are not suitable for general planting on home grounds where a more intimate kind of shrubbery is preferred.

Extensive Root System

Another important adaptation to drought is an extensive root system that can thoroughly exploit a large volume of soil and can extract from comparatively dry soil enough water to keep the plant in succulent condition. It is evident that only shrubs with this last type of adaptation, which enables them to live and retain their ornamental value in dry soil, are of much use for landscaping under droughty conditions. Fortunately, enough shrubs having this necessary characteristic are available to meet most landscaping needs on dry land.

Rose Family

The rose family contains many drought-tolerant species. Three of these native to the western United States deserve more attention than they have received. The

black choke-cherry (*Prunus virginiana* var. *melanocarpa*) is a tall shrub, more bushlike than the eastern choke-cherry. The fruits, either black or yellow, are less astringent and are prized for making jelly and table syrup. In spring the bush is covered with racemes of fragrant, white flowers. A red-leaved form, called "Schubert," is a recent valuable addition to hardy, red-foliaged shrubs. Choke-cherries sucker somewhat but this fault is usually not serious under dry conditions.

Boulder raspberry (*Rubus deliciosus*) is an attractive, medium-height shrub native to the foothills and canyons of the Rocky Mountains. Both botanists and horticulturists seem to have had difficulty naming this shrub. The genus has been called also *Bossekia* and *Oreobatus* and the plant has been called false raspberry and thimbleberry; but the name boulder raspberry now seems to be generally accepted. The bush is compact and graceful, with white, showy flowers resembling large single roses. The purplish, insipid fruits are relished by birds.

Apache plume (*Fallugia paradoxa*) is an interesting desert shrub of the southwest that will grow much farther north than its native range would indicate. The plant is spreading, rarely more than 3 feet tall, with white branches and small foliage that remains green most winters even in cold climates. The large white flowers, like single roses, are open all summer long and are followed by decorative, purplish plumes similar to those of clematis and useful for winter bouquets.

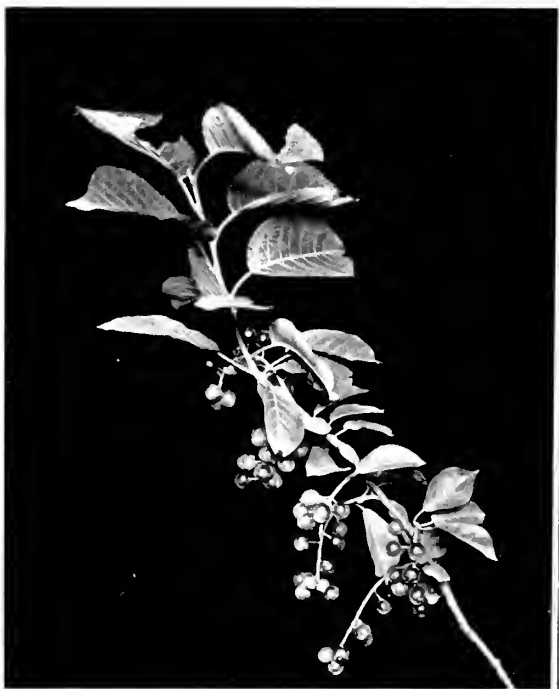
Shrubby cinquefoils are good dry-land shrubs noted for their abundance of flowers throughout summer. Of the many kinds in cultivation Farrer bush cinquefoil (*Potentilla fruticosa* var. *farrereri*) is best for dry conditions because its foliage retains its deep green color during droughts, making a good background for the bright yellow flowers. The neat bush is about 3 feet high.

Among the cotoneasters are several valuable species hardy to cold and



Elsie M. Kittredge photos

Flowering and fruiting branches of choke-cherry (*Prunus virginiana*); certain varieties deserve more attention for dry places





Roche photos

Flowers of silverberry (*Elacagnus commutata*), yellow and very fragrant

drought. Most common is the Peking cotoneaster (*Cotoneaster acutifolia*), a rather upright shrub of medium height with glossy foliage and abundant black

berries that hang on the branches all winter. The autumn foliage has a rich wine-color. European cotoneaster (*C. integerrima*) is more spreading than the



The ornamental fruits of silverberry remain on the shrub through the winter

preceding species, with blue-green foliage and red berries. Sungari rockspray cotoneaster (*C. racemiflora* var. *soongorica*) is somewhat similar to European

cotoneaster but larger in every way and the branches are more horizontal. The large, red fruits make an interesting contrast with the blue-green foliage. This

is a dense shrub, excellent for specimens or for informal hedges. *C. multiflora* is a graceful bush about 6 feet tall, upright in habit, with slightly arching branches and red fruits in autumn. Unlike most cotoneasters the last two species have attractive white flowers in springtime.

Oleaster and Pea Families

It is often said that the predominant foliage color in dry climates is gray rather than green. Certainly many of our drought-resistant shrubs have a silvery cast. Two members of the oleaster family native to the northern Great Plains are valuable ornamentals where gray color is desired. Buffalo-berry (*Shepherdia argentea*) is a tall shrub with gray foliage and red or yellow berries that persist after leaf-fall. The fruits make a delicious jelly. There are male and female plants and at least one male must be included as pollinizer in each planting; otherwise there will be no berries. Silver-berry (*Elaeagnus commutata*) has a metallic silvery sheen on both leaves and fruits that is rare in the plant kingdom. The shrub is about 6 feet high, with yellow, very fragrant flowers in spring and large silvery berries that hang on all winter. Both of these shrubs have a tendency to send up sprouts.

The pea family has many drought-resistant species and some of them are desirable ornamental shrubs. Lead-plant (*Amorpha canescens*) is another gray-foliaged plant. In late summer it is covered with violet-colored flowers on spikes clustered at the ends of the branches. The height is rarely over 3 feet. The shape is thoroughly informal, which characteristic has led some landscape architects to favor this shrub for planting around informal, ranch-style homes.

Caraganas comprise a large group of leguminous shrubs noted for drought tolerance. Some of them have considerable ornamental value. *Caragana arborescens*

forma *lorbergii* is a tall shrub with fine foliage similar in effect to asparagus fern. At the other end of the scale is *C. auran-tiaca*, a dwarf shrub rarely more than 2½ feet high. It is suitable for specimens, groups, or hedges. Because of its spines it makes a good substitute for Japanese barberry where that species will not survive because of drought and cold. The littleleaf caragana (*C. microphylla*) is perhaps the most useful for general planting. It is a medium-sized shrub of upright growth with fine branches and small leaves. The foliage is bluish green in color. A Canadian selection called "Tidy" is neater and more desirable than the species type. These three caraganas are hardy to cold and in early spring have attractive yellow flowers resembling sweet peas.

Mint and Vervain Families

Blue-flowered shrubs for northern climates are not particularly plentiful and summer flowering shrubs are also scarce. Both desirable characteristics are found in two drought-resistant species that deserve wider planting: perovskia (*Perovskia atriplicifolia*), a member of the mint family, is about 4 feet high with grayish aromatic foliage and panicles of attractive bluish-purple flowers at the ends of the shoots. The bush kills back in cold winters, behaving much as a herbaceous perennial. Mongolian bluebeard (*Caryopteris mongholica*), a member of the vervain family, is a low, spreading shrub about 2½ feet high. The shoots in summer become garlands of powder-blue flowers that bloom over a long period. As cut flowers they remain attractive for about two weeks.

It is evident that these various drought-tolerant species are widely distributed among plant families with no apparent similarities other than their adaptation to dry soils.



McFarland photos

The Cherokee rose (*Rosa laevigata*), a heavy-caned, white-flowered species useful in mild climates

ROSE SPECIES FOR THE GARDEN

A tough and hardy lot

R. C. Allen

THOSE who like the simple, natural, undeveloped plants will appreciate the wild or species roses. In habit of growth they range from prostrate creepers through shrubs of various heights and forms, to large and rampant climbers.

Botanists do not agree on the exact number of species known in the world today, but there are well over one hundred. The list of thirty in Bailey's *Manual of Cultivated Plants* represents those most commonly seen in American gardens. Of these, about ten are seldom used in their original form but are interesting because they are the ancestors of our modern hybrids.

Usefulness

Strictly speaking, most of the species roses are used in landscape plantings as flowering shrubs. While many of them possess qualities not present in other kinds of plant material, their value in both small and large gardens is essentially the same as that of other deciduous plants. They are excellent as a background for rose gardens, in a mixed shrub border, as foundation plantings, in combination with evergreens, as specimen plants, and some as ground covers.

Most of the species roses have only one period of bloom, but this does not mean that they lack interest at other seasons of the year. Certain kinds are even more beautiful in the fall when their fruits are ripe than they are when in flower. Some



The Japanese rose (*Rosa multiflora*), whose prolific flowers are followed by great masses of small, bright orange-red fruits

species have brightly colored stems that show vividly against snow or against an evergreen background. Certain species are appealing because of the rich color or delightful fragrance of the foliage.

Culture

The species roses are a tough and hardy lot. They grow well even in poor soil; in fact, some kinds may become too vigorous or rampant where the soil is very fertile. They need nearly full sunshine to grow and flower at their best. Good drainage is required.

As with other shrubs, some care should be taken in planting. Rarely is special soil preparation necessary beyond that done for similar plant material. Mixing some form of organic material, such as leaf mold or peat moss, with the soil which will be packed around the roots often helps the plants to become established.

When setting out the bushes, be sure to dig the hole large enough to accommodate the root system without much bending. Watering at the time of planting and keeping the soil moist during the first year help greatly to give the plants a good start.

Most of the cultural practices emphasized for the hybrid tea or other garden hybrid groups are not needed with species roses. Most of them will get along with partial neglect, but like other plants they respond to care. Fertilization, for example, is not necessary unless the soil is practically barren, but a top-dressing of manure each spring, or an application of a mixed commercial fertilizer will keep plants vigorous without their becoming rampant.

While the species roses are subject to the same insects and diseases as the highly developed varieties, they are rarely injured to so great an extent. This does not mean that they do not need spraying or dusting—only that they do not require quite so much as other roses.

In the spring it is always well to give a dormant spray of either oil emulsion or lime sulfur. This will eliminate the scale insects that are sometimes troublesome.

Later, when the aphids (or plant lice) appear, nicotine sulfate, rotenone, or other contact insecticide should be used. If rose slugs or other chewing insects are present, DDT or arsenate of lead will take care of them. While most of the species roses are quite resistant to diseases, blackspot and mildew may cause some injury; and so it is desirable to give one or two sprayings or dustings with sulfur or copper fungicides in the spring and again in the fall.

As with other shrubs, pruning is essential to keep the plants attractive in appearance. Pruning is usually done in the early spring, but it can be done immediately after flowering or even in the fall. The plants should not be allowed to get too thick or overgrown. Every few years it may be desirable to take out some of the older canes.

Species for the Garden

It is not easy to set up a selected list of the species roses. Each of those in cultivation has special merits that make it particularly valuable in certain situations. A few perhaps have faults that limit their general usefulness.

Of all of the rose species perhaps the one most widely grown and cherished is **Father Hugo's rose** (*Rosa hugonis*). This is one of the first to bloom in the spring. The plant is graceful in habit, and the long slightly arching canes are covered with single yellow blossoms. It is a spectacular plant, useful in many spots in the garden—as a specimen shrub, in combination with other flowering shrubs, or as background planting. Usually it grows about 8 feet tall, and a well-grown plant will have a spread of about 6 feet.

Next in importance, I would place *Rosa rugosa*, sometimes called the **hedgerow rose**. This is an excellent hedge rose growing 5 to 7 feet tall. It is more or less upright and has a rounded top. There are pink, red, and white botanical varieties and several named clones. The flowers are large and cup-shaped and are produced over most of the summer. The

leaves are large, shiny deep green; and the fruits are large and conspicuous even before the leaves drop. It is adapted to almost any situation where a flowering shrub of its height and form can be used.

The **Japanese rose** (*R. multiflora*) makes a large spreading shrub approximately 6 feet in height. When in flower it is almost a solid mass of clusters of small white blossoms. In the fall it again becomes prominent because of the great masses of small, bright orange-red fruits.

The **musk rose** (*R. moschata*) is another species, similar in growth and flowering habit but with larger arching canes. The individual flowers are also a little larger and the clusters are looser than those of the Japanese rose. The leaves are slightly glossy, but the outstanding quality is the wonderful musk fragrance. One plant will scent a whole garden. This species also produces abundant bright red fruits.

The **prairie rose** (*R. setigera*) is a fine large shrub, valuable because it is later-flowering than most other species and has unusual gray-green foliage. The plant, while a bit coarse, is very good in open, exposed situations. The flowers are 2 inches or more in diameter, rose-pink fading to white.

A thornless rose that has merit is the **meadow rose** (*R. blanda*). This species is at its best after the leaves fall and the bright shiny red twigs become visible. It is excellent in combination with evergreens, to give winter interest to the garden. Normally it grows 5 to 6 feet tall and takes on a bushy rounded form.

The rose with the most unusual foliage is the **red-leaf rose** (*R. rubrifolia*). Like many plants with colored leaves, it must be used carefully in the landscape plan. The leaves are a distinct purplish red which stands out prominently from normal green foliage. The twigs are also reddish purple in color. The plant grows 6 to 8 feet in height. The flowers are deep pink and not especially numerous, and the fruits are dark red.

Any garden that makes use of the species roses should include the **eglantine** or

sweetbrier (*R. eglanteria*). This is a stout erect bush sometimes reaching 8 feet. The flowers are single and pink and are borne in small clusters. The most interesting thing about this shrub, however, is the delightful odor of the foliage. It is very pronounced if the leaves are crushed or even if the plants are merely touched. The fruits are large and brilliant red.

The **Austrian brier** (*R. foetida*) is prized for the mass of bright yellow flowers it produces. They literally cover the plant. There are several varieties, the best-known of which is "Persian Yellow," with semidouble flowers. "Austrian Copper" is a brilliant coppery red. "Harison's yellow," a hybrid between the Austrian brier and the Scotch rose (*R. spinosissima*), is especially fine. It grows about 5 feet tall.

The rose with the largest fruits is the **apple rose** (*R. pomifera*). The scarlet fruits are approximately an inch in diameter and very showy. The blossoms are also large, and rose-pink in color. The plant reaches a height of about 6 feet.

A species rose largely overlooked today is the **cinnamon rose** (*R. cinnamomea*). It was very widely used in colonial times, especially in New England, and it can still be seen in old cemeteries and around old farm houses or cellar holes. The bush often grows 6 feet high and bears a profusion of 2- to 3-inch fragrant blooms which are usually double and light rose-pink in color.

One of the tallest-growing species of bush rose is **Moyes rose** (*R. moyesi*). It makes a splendid large shrub with large dark red flowers. The fruits are an attractive bright red.

For mild climates there are two fine species roses: the **Cherokee rose** (*R. laevigata*), and the **Banksia rose** (*R. banksiae*). Both of these are climbers. The Cherokee is a coarse heavy-caned climber, with pink or white flowers, while the Banksia rose has very long slender canes and flowers of yellow or white.

Perhaps no group of plants offers a wider variety of useful garden material than the species roses.



Flowers of musk rose (*Rosa moschata*), outstanding for bountiful fragrance



Richard Averill Smith photos

Mountain-laurel (*Kalmia latifolia*), useful in many ways

FLOWERING SHRUBS IN THEIR SEQUENCE OF BLOOM

Donald Wyman

The time given is for Boston, Massachusetts, but can easily be correlated for any part of the country. See the discussion in *PLANTS & GARDENS*, Spring, 1950, pages 29 to 31. The sequence indicates the order in which the plants *begin* to bloom; no attempt is made to show the whole period of bloom, or the overlapping that occurs in many cases.

An asterisk (*) after a name indicates an illustration in color in this issue.

Time	Name	Height of Shrub in Feet	Color of Flower
February			
	vernal witch-hazel (<i>Hamamelis vernalis</i>)	10	yellow and red
March			
	Chinese witch-hazel (<i>Hamamelis mollis</i>)*	30	yellow
	European filbert (<i>Corylus avellana</i>)	15	(catkins)
Early April			
	Cornelian-cherry (<i>Cornus mas</i>)	24	yellow
	Japanese cornel dogwood (<i>Cornus officinalis</i>)	15	yellow
	February daphne (<i>Daphne mezereum</i>)	3	rosy pink
	spring heath (<i>Erica carnea</i>)	1	rosy red
	winter jasmine (<i>Jasminum nudiflorum</i>)	15	yellow
	fragrant viburnum (<i>Viburnum fragrans</i>)	9	white

<i>Time</i>	<i>Name</i>	<i>Height of Shrub in Feet</i>	<i>Color of Flower</i>
Mid-April			
	Korean abelia-leaf (<i>Abeliophyllum distichum</i>)	5	white
	Chinese winter-hazel (<i>Corylopsis sinensis</i>)	10 to 18	yellow
	trailing arbutus (<i>Epigaea repens</i>)	ground cover	white to pink
	forsythia (<i>Forsythia</i> species)*	2 to 9	yellow
	spice-bush (<i>Lindera benzoin</i>)	15	greenish yellow
	winter honeysuckle (<i>Lonicera fragrantissima</i>)	6	white
	Japanese andromeda (<i>Pieris japonica</i>)	9	creamy white
	Korean rhododendron (<i>Rhododendron mucronulatum</i>)	6	pale rosy purple
Late April			
	star magnolia (<i>Magnolia stellata</i>)	20	white
	mountain andromeda (<i>Pieris floribunda</i>)	6	white
	Manchu cherry (<i>Prunus tomentosa</i>)	9	white
	flowering almond (<i>Prunus triloba</i>)	15	pink
	bridal-wreath (<i>Spiraea prunifolia</i>)	9	white
	<i>Stachyurus praeox</i>	12	greenish yellow
Early May			
	apple service-berry (<i>Amelanchier grandiflora</i>)	25	white
	running service-berry (<i>Amelanchier stolonifera</i>)	4	white
	oriental flowering quince (<i>Chaenomeles</i> species and vars.)*	3 to 6	red, white, pink
	lilac daphne (<i>Daphne genkwa</i>)	3	lilac
	mahonia (<i>Mahonia</i> species)	3 to 12	yellow
	dwarf flowering almond (<i>Prunus glandulosa</i>)	4½	pink or white
	beach plum (<i>Prunus maritima</i>)	6	white
	snow azalea (<i>Rhododendron mucronatum</i>)	6	white
	clove currant (<i>Ribes odoratum</i>)	6	reddish to yellow
	Thunberg spirea (<i>Spiraea thunbergi</i>)	5	white
	Korean early lilac (<i>Syringa oblata dilatata</i>)	12	pinkish
	hobble-bush (<i>Viburnum alnifolium</i>)	12	white
	Japanese barberry (<i>Berberis thunbergi</i>)	7	yellow
	sweet-shrub (<i>Calycanthus floridus</i>)	9	dark reddish brown
	Siberian pea-tree or pea-shrub (<i>Caragana arborescens</i>)	18	yellow
	Warminster broom (<i>Cytisus praeox</i>)	6	lemon yellow
	Scotch broom (<i>Cytisus scoparius</i>)	6	yellow
	red-vein enkianthus (<i>Enkianthus campanulatus</i>)	30	yellowish white
	common pearl-bush (<i>Exochorda racemosa</i>)	15	white
	fothergilla (<i>Fothergilla</i> species)	3 to 6	white
	kerria (<i>Kerria japonica</i>)	4 to 6	yellow
	rhodora (<i>Rhododendron canadense</i>)	3	rose-purple
	Carolina rhododendron (<i>Rhododendron carolinianum</i>)	6	pale rosy purple
	Hiryu azalea (<i>Rhododendron obtusum</i> vars.)	3	red, pink, white
	royal azalea (<i>Rhododendron schlippenbachii</i>)	15	rose pink
	pink-shell azalea (<i>Rhododendron roseyi</i>)	6 to 9	light rose
	Yodogawa azalea (<i>Rhododendron yedoense</i>)	5	spotted cyclamen pur- ple
	jetbead (<i>Rhodotypos scandens</i>)	6	white
	scarlet elder (<i>Sambucus pubens</i>)	12 to 24	yellowish white
	common lilac (<i>Syringa vulgaris</i> , many vars.)*	20	lilac, pink, white
	Burkwood viburnum (<i>Viburnum burkwoodii</i>)*	6	pinkish to white
	Mayflower or fragrant viburnum (<i>Viburnum carlesii</i>)	5	pink to white
	weigela (<i>Weigela</i> hybrids)*	12	white, rose, pink, pur- ple
Late May			
	red chokeberry (<i>Aronia arbutifolia</i>)	9	white or reddish
	warty barberry (<i>Berberis verruculosa</i>)	4	golden yellow
	red-osier dogwood (<i>Cornus stolonifera</i>)	7	dull white
	Giraldi daphne (<i>Daphne giraldi</i>)	2	yellow
	slender deutzia (<i>Deutzia gracilis</i>)	3 to 6	white

Time	Name	Height of Shrub in Feet	Color of Flower
	Lemoine deutzia (<i>Deutzia lemoinei</i>)*	7	white
	Morrow honeysuckle (<i>Lonicera morrowi</i>)	6	white
	Tatarian honeysuckle (<i>Lonicera tatarica</i>)	9	pink to white
	tree peony (<i>Paeonia suffruticosa</i>)	4 to 5	white, rose, or red
	Amur ninebark (<i>Physocarpus amurensis</i>)	9	white
	bush cinquefoil (<i>Potentilla fruticosa</i>)	4	yellow
	rhododendron "Boule de Neige" (<i>Rhododendron caucasicum</i> hybrid)	6	white
	Ghent hybrid azaleas (<i>Rhododendron gandavense</i> vars.)	6	many colors
	Japanese azalea (<i>Rhododendron japonicum</i>)	6	orange red or salmon red
	mollis hybrid azaleas (<i>Rhododendron molle</i> vars.)	4	golden yellow to orange and red
	pinxter-bloom (<i>Rhododendron nudiflorum</i>)	6	light pink
	Father Hugo's rose (<i>Rosa hugonis</i>)	7	canary yellow
	primrose rose (<i>Rosa primula</i>)	8	light yellow
	Vanhoutte spirea (<i>Spiraea vanhouttei</i>)	6	white
	Chinese lilac (<i>Syringa chinensis</i>)	15	purple
	Persian lilac (<i>Syringa persica</i>)	6	pale lilac
	small-flowered tamarix (<i>Tamarix parviflora</i>)	15	pink
	highbush blueberry (<i>Vaccinium corymbosum</i>)	12	white or pinkish
	nanny-berry (<i>Viburnum lentago</i>)	30	white
	Chinese snowball (<i>Viburnum macrocephalum sterile</i>)	12	white
	European snowball (<i>Viburnum opulus roscum</i>)	12	white
	Siebold viburnum (<i>Viburnum sieboldi</i>)	30	creamy white
	Japanese snowball (<i>Viburnum tomentosum sterile</i>)	9	white
Early June			
	alternate-leaved buddleia (<i>Buddleia alternifolia</i>)	12	lilac purple
	fringe-tree (<i>Chionanthus virginicus</i>)	30	white
	Tatarian dogwood (<i>Cornus alba</i>)	9	yellowish white
	beauty-bush (<i>Kolkwitzia amabilis</i>)	10	pink
	drooping leucothoe (<i>Leucothoe catesbaei</i>)	6	white
	mock-orange (<i>Philadelphus</i> , many species and vars.)	4 to 12	white
	flame azalea (<i>Rhododendron calendulaceum</i>)	9	yellow or orange to scarlet
	Catawba rhododendron (<i>Rhododendron catawbiense</i> and vars.)	6 to 18	lilac purple
	Austrian copper brier (<i>Rosa foetida bicolor</i>)	9	red
	Harison's yellow rose (<i>Rosa harisoni</i>)	6	yellow
	rugosa rose (<i>Rosa rugosa</i>)	6	pink to white
	Scotch rose (<i>Rosa spinosissima</i>)	3	pink, white, or yellow
	Preston lilacs (<i>Syringa prestoniae</i> and vars.)	9	pink
	late lilac (<i>Syringa villosa</i>)	9	rosy lilac to white
	linden viburnum (<i>Viburnum dilatatum</i>)	9	creamy white
	arrow-wood (<i>Viburnum dentatum</i>)	15	creamy white
	European cranberry-bush (<i>Viburnum opulus</i>)	12	white
	old-fashioned weigela (<i>Weigela florida</i>)	9	white, sometimes pinkish
Mid-June			
	gray dogwood (<i>Cornus racemosa</i>)	15	creamy white
	cotoneaster (<i>Cotoneaster multiflora</i>)	8	white (small)
	deutzia "Contraste" (<i>Deutzia</i> hybrid)	6	pinkish
	mountain-laurel (<i>Kalmia latifolia</i>)	30	pink and white
	common privet (<i>Ligustrum vulgare</i>)	15	white
	mock-orange (<i>Philadelphus</i> , many vars.)	4 to 9	white
	Laland firethorn (<i>Pyracantha coccinea lalandi</i>)	6	white
	sweet azalea (<i>Rhododendron arborescens</i>)	9	white
	cabbage rose (<i>Rosa centifolia</i>)	6	pink
	Japanese rose (<i>Rosa multiflora</i>)	10	white
	Virginia rose (<i>Rosa virginiana</i>)	6	magenta to pink



Forsythia trained to grow over the garden gate—bids a cheery springtime welcome

Time	Name	Height of Shrub in Feet	Color of Flower
Late June			
	snow-flake deutzia (<i>Deutzia scabra candidissima</i>)	8	white
	virginal mock-orange (<i>Philadelphus virginialis</i>)	5 to 9	white
	rose-bay rhododendron (<i>Rhododendron maximum</i>)	12 to 36	rose to purple-pink
	American elder (<i>Sambucus canadensis</i>)	12	white
	Ural false-spirea (<i>Sorbaria sorbifolia</i>)	6	white
	Bumalda spirea (<i>Spiraea bumalda</i> and vars.)	2	bright crimson
Early July			
	snow-hill hydrangea or hills-of-snow (<i>Hydrangea arborescens grandiflora</i>)	3	white
	Henry St. Johnswort (<i>Hypericum patulum henryi</i>)*	3	yellow
	swamp azalea (<i>Rhododendron viscosum</i>)	9 (rarely 15)	white
	prairie rose (<i>Rosa setigera</i>)	15	rose
	flowering raspberry (<i>Rubus odoratus</i>)	9	purple
Mid-July			
	bottlebrush buckeye (<i>Aesculus parviflora</i>)	8 to 12	white
	oak-leaf hydrangea (<i>Hydrangea quercifolia</i>)	6	white
Late July			
	heather (<i>Calluna vulgaris</i>)	1½	white to red
	summer-sweet (<i>Clethra alnifolia</i>)	9	white
	shrubby St. Johnswort (<i>Hypericum prolificum</i>)	3	bright yellow
	Japanese shrub bush-clover (<i>Lespedeza bicolor</i>)	9	rosy purple
August			
	glossy abelia (<i>Abelia grandiflora</i>)	5	pink
	David buddleia (<i>Buddleia davidi</i>)	15	white, pink, red, purple
	rose-of-Sharon (<i>Hibiscus syriacus</i>)	15	white to blue
	Pee Gee hydrangea (<i>Hydrangea paniculata grandiflora</i>)	25	white
	crape-myrtle (<i>Lagerstroemia indica</i>)	21	bright pink to red
	cut-leaved chaste-tree (<i>Vitex negundo incisa</i>)	15	lilac or lavender
September			
	groundsel-bush (<i>Baccharis halimifolia</i>)	12	white
	Staunton elsholtzia (<i>Elsholtzia stauntoni</i>)	5	lilac purple
October			
	common witch-hazel (<i>Hamamelis virginiana</i>)	15	yellow
	Japanese bush-clover (<i>Lespedeza japonica</i>)	6	white

THE BROOMS

There are several brooms that produce bright-colored flowers. For instance, the **Warminster broom** (*Cytisus praecox*) has pale yellow flowers profusely borne in mid-May at the time the Korean azalea is in flower. The common **Scotch broom** (*C. scoparius*) has been naturalized in several parts of the country, and its deep golden yellow flowers are common sights in Virginia and Cape Cod, and along the northwest Pacific Coast. The little **purple broom** (*C. purpureus*) seldom grows

over 18 inches high, and its purple flowers are very conspicuous in mid-May.

However, all these brooms are difficult to transplant and had best be bought in pots from the commercial propagator and set out into their permanent place directly from the pots. They usually do well in a very poor dry soil, sometimes even better than in good fertile garden soil. In the right place, they are of perennial interest because of their bright spring flowers and their green twigs which are most prominent the entire year.

FLOWERING SHRUBS IN CALIFORNIA GARDENS

Color throughout the year

Vernon T. Stoutemyer

WORLD travelers have sometimes ranked Californians with the Scandinavians in appreciation and use of color. This is reflected in California gardens, which provide abundant color throughout the year in the warmer portions of the state. This continuous succession of color may be obtained by the alternation of warm-season and cool-season annuals, and by the use of bulbous plants or herbaceous perennials. However, an easier way to obtain the same effect is through the use of woody flowering plants, which have become so popular that many fine herbaceous perennials which are well adapted to the climate are rarely seen, especially in the southern portion of the state.

Flowering shrubs have many uses. They provide permanent foliage for the landscape and also cut flowers for home decoration. Gardenias, camellias, fuchsias, and others furnish abundant material for corsages. Shrubs such as banana-shrub (*Michelia fuscata*), breath-of-heaven, thorny elaeagnus, night-blooming cestrum, various rain-trees (*Brunfelsia*), daphnes, jasmines, gardenias, the Chinese star-jasmine, sweet osmanthus, and some of the pittosporums have a pleasing fragrance.

Winter-blooming and Ever-blooming Shrubs

Fortunately, many shrubs will give winter bloom in the warmer areas of the state. A long sequence may be obtained with the various South African and Mediterranean heathers. Poinsettias, single and double, in several colors are showy for many months. The yellow bush-daisies of South Africa (*Euryops pectinata* and *Euryops athanasiae*) are

excellent garden shrubs. Queens bird-of-paradise-flower (*Strelitzia reginae*) furnishes an important florists' cut flower. The dombeyas are large shrubs with pink or white flowers. Several sennas (*Cassia*), including golden-wonder senna (*Cassia splendida*), woolly senna (*C. tomentosa*), and wormwood (*C. artemisioides*), furnish abundant yellow color in the winter. The tree medic (*Medicago*



Photo courtesy of Armstrong Nurseries

One of the South African bush-daisies,
Euryops athanasiae

arborca) will bloom through severe freezing weather. In favorable locations, a number of varieties of the tropical hibiscus bloom in the winter.

A number of shrubs are practically everblooming, including the bush and trailing lantanas, the red-purple *Cestrum elegans*, brilliant orange *Streptosolen jamesoni*, and *Polygala dalmaisiana*. The canary-bird-bush (*Crotalaria agatiflora*) has curious chartreuse-colored flowers shaped like a canary bird, and these make excellent corsages and floral arrangements. (See illustration in color section.) The Chinese hat-plant (*Holmskioldia sanguinea*) has curious hat-shaped flowers usually of a brick-red color. Some of the deciduous trees and shrubs start to bloom very early in the winter in the southern portion of the state and are much used in the colder areas.

Varied Materials

The ornamental plant materials available in California are amazingly varied; probably in few parts of the world can more different species of plants be grown than in the coastal region of the state. The equable character of the climate explains why a plant such as the Irish-heath (*Daboecia cantabrica alba*) will flourish here beside palms and bananas. Since there is no truly tropical area, plants which cannot endure temperatures slightly below freezing for several hours are not commonly cultivated outdoors. This excludes many plants, but a surprising number of the hardier tropical plants are found in the southern coastal region, particularly in sheltered spots. On the other hand, numerous plants from the colder temperate regions are found, although some of the hardy woody plants may exhibit delayed foliation due to insufficient cold to break the winter rest period.

Climatic Variations

The climate of the state is classified as the Mediterranean type, in which the rainfall is normally confined to the winter months. Still other areas of the world

having similar climates are found in South Africa, Australia, and Chile. Many of the plants of all these regions are drought resistant and thrive under conditions favorable to the growth of many California native plants. However, California has exceptionally wide variations of climate, and there are also different climatic zones in the other countries mentioned. Accordingly, sweeping generalizations cannot be made concerning the cultural requirements of plants from any of these regions.

Native Shrubs

The prevalence of heavy soils, and the abundant watering which is common in the average garden at the present time, explain the relatively limited use of some of the most spectacular native flowering shrubs, including the San Diego fremontia and the numerous "wild lilacs" (species of *Ceanothus*). The latter range from tree-like forms such as the felt-leaf ceanothus (*C. arborescens*) to diminutive ground covers, of which the Point Reyes creeper (*Ceanothus gloriosus*) is typical. Many of these species have fine evergreen foliage and bloom abundantly in their season but are short-lived in the average garden. Some of the California natives, as for example the matilija-poppy (*Romneya coulteri*) and the carpenteria, are more dependable. Other easily grown native flowering shrubs of outstanding merit include several flowering currants, redbud, silk-tassels (*Garrya*), the tree-poppies (*Dendromecon*), the Apache plume, the bush snapdragon, and a number of the sages.

Some of the desert areas of the state are undergoing rapid development as winter resorts. The characteristic plants of these areas are being used for landscape plantings with striking success. Many of these plants will grow in other districts as well, and have been used when they fit the architecture. The native ocotillo, various yuccas, agaves, cacti, desert-willow, parkinsonia, and other desert trees and shrubs give a unique atmosphere to plantings when appropriately used.

Felt-leaf ceanothus (*C. arbo-
reus*), sometimes called "wild
lilac"



Photo courtesy of Santa Barbara Botanic Garden

Australian Shrubs

The wealth of suitable flowering shrubs is so great that many excellent species seldom or never are available in the nurseries. The lists of landscape shrubs could doubtless be extended greatly by new introductions from several portions of the world. Australian plants are frequently strikingly showy, and are probably the most important elements in landscape planting in California at the present time. The shrubby acacias are notable for their abundant yellow flowers in winter. The bottle-brushes, including *Callistemon* and melaleucas, often have strikingly brilliant flowers. The Geraldton wax-flower (*Chamaelaucium*) in various colors is a splendid cut flower. The so-called Australian-fuchsias, or correas, and the flame-peas (*Chorizema*) furnish abundant winter bloom. The Australian

bluebell-creeper (*Sollya heterophylla*) can be used as a ground cover, a shrub, or a low vine. Some of the banksias are being grown commercially for florist use, probably because of their striking and unusual form. Many Australian plants are quite drought resistant.

New Zealand and South African Shrubs

Plants from New Zealand are generally better adapted to the north coastal fog belt than to Southern California. However, some of the hebes (or shrubby-veronicas) grow well in the south coastal area, and are valuable both for foliage and for flowers. Iron-tree (*Metrosideros tomentosa*) is slow-growing and seldom seen as large specimens, but is one of the best tall shrubs for exposed situations on the seashore. It has flamboyant red

flowers in early summer, unlike most New Zealand plants, which generally have flowers with soft, inconspicuous colors.

Many of the South Africa flowering shrubs come from a similar climate; but some of them prefer an acid soil, which is seldom encountered in Southern California. Proper soil preparation would doubtless help to popularize the cultivation of more of the unusual shrubs in the family Proteaceae.

Mediterranean and South American Shrubs

Many plants from the Mediterranean region, including flat-pod (*Adenocarpus*), broom (*Cytisus*), rock-rose (*Cistus*), sun-rose (*Helianthemum*), coronilla, and others require little water and care and are floriferous. The Spanish-broom (*Spartium junceum*) has become naturalized in Southern California, where it has advanced to altitudes of several thousand feet.

Valuable shrubs have come from the higher elevations of tropical countries. The rondeletias from South America are popular where frosts are not severe. A most striking recent introduction from this region is the large pink-flowered *Calliandra inaequilatera*, which makes an ideal plant for espaliering on a wall. The large purple-flowered Brazilian glory-bush (*Tibouchina semidecandra*) is an outstanding ornamental along the coast. The escallonias are also well adapted to this area.

New Plants, New Uses

There are several ways in which the horticultural wealth of the Pacific coast can be developed. Old plants can be used in new ways through experimentation. For instance, many shrubs are showing a surprising adaptability for use as espalier plants. These are displacing vines to some extent for use on walls. On the other hand, some vines are being grown as shrubs or ground covers. The Chinese star-jasmine (*Trachelospermum jasminoides*) is now extensively used as a ground cover; and a few varieties of

bougainvilleas, including "Barbara Karst," have a habit of growth which makes them usable as ground cover shrubs. Bold experimentation by landscape architects is increasing knowledge of unusual uses of plant materials.

Several botanic gardens and arboreta have made valuable contributions to horticulture. The Rancho Santa Ana Botanic Garden and the Santa Barbara Botanic Garden have worked with the native flora. The Strybing Arboretum at Golden Gate Park in San Francisco and the University of California Botanic Garden at Berkeley have introduced many plants. An arboretum is located on the Los Angeles campus of the latter institution. Some of the collections of the Huntington Botanic Garden at San Marino are notable. The new Los Angeles State and County Arboretum at Arcadia will doubtless introduce many new plants into cultivation. A great many plants from various parts of the world deserve testing for use in California.

Much can also be done in the development of flowering shrubs by breeding. At the present time activity is largely concentrated in the most popular subjects. The activity in fuchsia breeding is notable, doubtless because this is the only area in the country in which fuchsias do well outdoors. There is much hybridizing in roses and in camellias. A few hybrids of the native *Ceanothus* have been introduced from time to time. Varieties of broom tea-tree (*Leptospermum scoparium*) in single and double pinks, reds, and whites, have been introduced in the nursery trade recently. These are being grown commercially for cut flowers. (See illustration in color section.) A small amount of breeding of the tropical hibiscus has been done, but unfortunately seeds do not set well in most localities.

Except for a few of the important woody shrubs, most of the landscape ornamentals used in California have not attracted the attention of the plant breeder. Doubtless there are great potentialities for the future in hybridization of landscape shrubs for subtropical regions.



Gotttscho-Schleisner photo

A few well-placed shrubs add special charm to a well-designed house

OTHER FLOWERING SHRUBS

Not to be overlooked

Donald Wyman

A FEW miscellaneous shrubs are mentioned here, which should not be overlooked even though they may not be among the best available. For instance, the **Chinese redbud**, the **pearl-bush**, and the **deutzias** (illustrated in color) are all valued spring-flowering shrubs frequently used in home plantings.

The **fringe-tree** (*Chionanthus virginicus*) is especially interesting. Closely related to the lilac, it has a myriad of small narrow flower petals that appear in early June and literally cover the entire plant. Usually it is grown as a large shrub but sometimes it has a single trunk. The

white flowers are followed in the fall by clusters of grape-like fruits, dark blue in color and not particularly outstanding, although the birds apparently come from miles around for them the minute they are ripe!

The **oriental tree peony** is fast becoming a shrub highly in demand, not necessarily for its habit or foliage, but for its large conspicuous flowers that appear in late May. The flowers of some of the varieties are as much as 14 inches across! The plants do not grow over 4 to 5 feet in height and should be selected for their flower color, which ranges from pure white to the deepest reds and reddish purples. Some of the flowers are double, like the old-fashioned "Souvenir de Maxine Cornu," which is yellow with



McFarland photos

Oak-leaf hydrangea
(*H. quercifolia*)

red markings; it frequently has flower heads so large and heavy that they must be staked to prevent them from falling over on the ground. There are also varieties that are single. Planting of these is best done in October in a rich, well-drained soil. They like plenty of lime, too.

In late May the **weigela** clan starts to bloom, shrubs not over 12 feet tall but usually kept much lower than this by vigilant pruning. Many varieties of these lime-loving plants are available, ranging in color from pure white to the deepest of reds, found in varieties such as "Bris-

tol Ruby" (see illustration in color section) and "Vanicecki." **Spireas** too, bloom at the same time; and with a proper selection of species this bloom is carried over into summer. The little "Anthony Waterer" spirea is widely valued for its red flowers in large flat clusters. It seldom grows over 2 feet tall; it can be cut to the ground occasionally in order to force vigorous growth, which of course produces large and bright-colored flowers. Both the weigelas and the spireas have a large number of varieties; they are easily propagated and are not among the most expensive of flowering shrubs either.



Lemoine deutzia (*D. lemoinei compacta*)

They can be expected to grow well in a wide variation of soils.

One plant might be mentioned here that is available from only one or two nurseries; but when it is in bloom, there is nothing like it in northern gardens. This is the **alternate-leaved buddleia** (*B. alternifolia*); it grows about 12 feet tall and is often called **fountain buddleia** because of its wide arching branches that are actually covered with small, blue flowers. In bloom by early June, it is easily one of the most distinctive of shrubs, but unfortunately it has nothing of much ornamental value at other times of the year.

The many species and varieties of **rhododendron** and **azalea** are not specifically mentioned here by their individual names because space is limited. Much has been written about them in

books and articles, so that ready references are easily available.¹ Certainly they should be included in any list of shrubs for consideration where acid soils are available. The number grown in commercial nurseries in America is well in the hundreds, certain groups being adapted to certain definite parts of the country. They bloom in May and June, some of the azaleas even a month earlier or later. As a group they might easily be considered to have the most vividly colored flowers of all shrubs used today.

Common flowering shrubs like the **hills-of-snow hydrangea** (*H. arborescens grandiflora*) and its overplanted larger and coarser relative the **Pee Gee hydrangea**, are widely grown. Perhaps

¹ See PLANTS & GARDENS, Spring, 1949; Autumn, 1949, pages 145-148 and 187-188; and Winter, 1950, pages 220-228.



Roche photos

Flowers and fruits of American elder (*Sambucus canadensis*), a shrub best used in wet areas



the little **oak-leaved hydrangea** might also be mentioned, for south of New York it makes an excellent low mass of foliage, not over 6 feet tall and usually much less; its handsome leaves are somewhat the same shape as those of the red oak. As it is a stoloniferous shrub, it increases rapidly and for this reason it is rather difficult to use in combination with other shrubs.

The **elderberries** are coarse, lanky shrubs that are sometimes used in naturalistic plantings; they have large clusters of white flowers. **Firethorns** (*Pyracantha* species) are usually planted for their brilliant scarlet berries, but they can be used for their many clusters of small white flowers also. The several **indigo** species (*Indigofera*) are useful for summer bloom in dry soils. It was some of these species that the early Carolina settlers tried to grow to produce dyes on a paying scale.

The **bush-clover** (*Lespedeza bicolor*) can make a considerable show in the summer with its rosy purple flowers, even though it dies to the ground in the winter. Both the **snowberry** and the **coral-berry**, low midwestern natives, are grown chiefly for their fruits; but their small pink flowers, in the summer, add to their usefulness in front of taller shrubs or in the foundation planting about the house. **Summer-sweet** (*Clethra alnifolia*) is one more native valued for its summer display of white flower spikes. It does well along the seacoast and seems to prefer moist soils.

The shrubs mentioned here constitute a hodgepodge of miscellaneous plants, any one of which, if used properly, can bring interest into the planting about the home. They are not the only ones either, but are mentioned here to point out the fact that gardeners in North America are unusually fortunate in having a tremendous variety of shrubs available for landscape planting. The more these gardeners become familiar with the ornamental qualities of the plants available, the better and more interesting can become the plantings about the homes in America.



Richard Averill Smith photo

Japanese snowball (*Viburnum tomentosum sterile*), the best of—

THE SNOWBALLS

There are three snowballs (all of them actually viburnums) which are available for planting in America. One is a native of China, another a native of Europe, and the third a native of Japan. Each is popular in its own right. The flowers of all of these snowballs are sterile, hence no fruits are produced.

The **Chinese snowball** (*Viburnum macrocephalum sterile*) is the largest in habit and in flower; it is not hardy much north of Philadelphia, although there is a plant which has successfully fought for its existence in the Arnold Arboretum in Boston for the past fifteen or twenty years. The flowers of this variety are as much as 3 to 6 inches in diameter.

The **European snowball** (*V. opulus roseum*) was probably the first one intro-

duced into the United States and has been widely distributed. Unfortunately it becomes seriously infested with plant lice, often so much so that the flowers and leaves and even the twigs are deformed. For this reason it should not be grown. It is the only snowball thus affected.

The best snowball for northern gardens, even though it is slightly less hardy than the European one, is the **Japanese snowball** (*V. tomentosum sterile*). The flower heads of this variety are about 2½ to 3 inches in diameter. It can be distinguished from the European one by the fact that its twigs are slightly brown-pubescent, while those of the European are smooth. But remember, the snowballs never bear fruit.



WITHIN THE BROOKLYN BOTANIC GARDEN

MIDWINTER TRIP TO THE TROPICS

In vast contrast with the penetrating rain and snow of a winter night in New York is the Tropical Forest in the conservatory of the Brooklyn Botanic Garden. On the occasion of a benefit reception on the eleventh of January, visitors to this conservatory were transported as if by magic on a visit to the tropics. Equatorial birds of gorgeous plumage and sounds of the jungle heightened the realistic effect. An eerie feeling was produced by the aerial roots of a tropical grape hanging in long strands from the highest rafters and lighted by a soft glow

not unlike tropical moonlight. Special lights dramatized other unusual plant features, such as a large bunch of ripening bananas, many kinds of orchids, the octopus-like supporting roots of a cut-leaf philodendron, the upward spiral of a screw-pine, and the rich purple flowers of a bromeliad (a relative of the pineapple). Over three hundred guests lingered in this tropical wonderland before and after a showing of J. Arthur Rank's "The Great Mr. Handel." After the motion picture, a candlelight buffet supper was served in the Rotunda.

COMING EVENTS

Plans are being made for Members of the Garden to visit outstanding private gardens on Long Island on May 15 or 16. Details will be sent to Members later.

BROOKLYN BOTANIC GARDEN
OF
THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES

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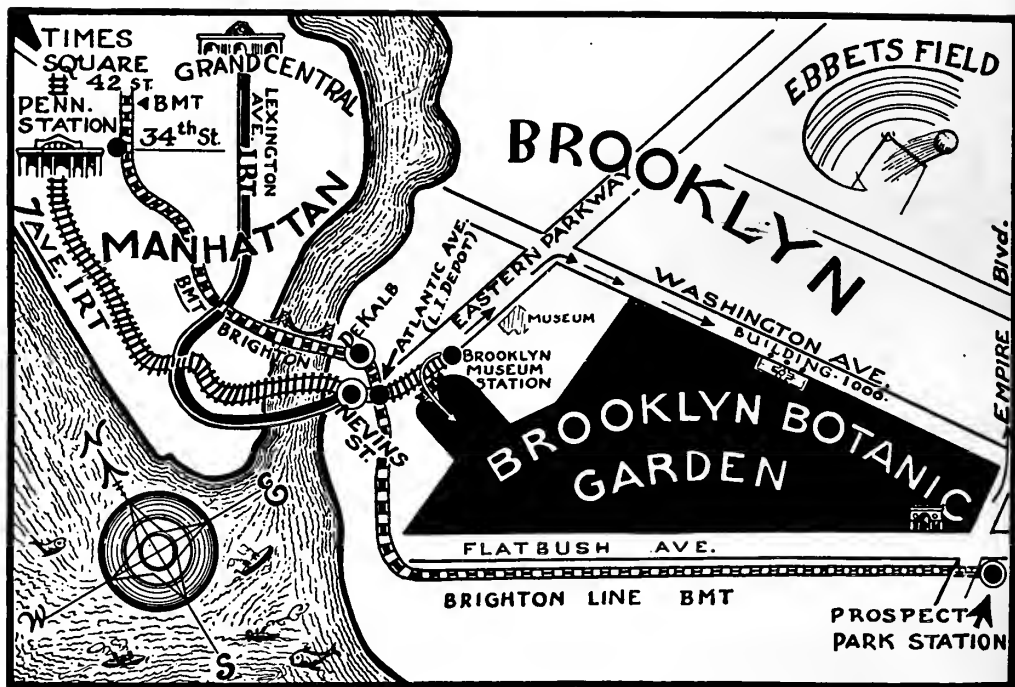
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GEORGE S. AVERY, JR.



TO VISITORS

To reach the Garden:

By SUBWAY: from Manhattan, twenty-five to thirty minutes' ride from Times Square or Grand Central.

I.R.T., West Side (7th Avenue or Broadway-7th Avenue line), downtown express marked "New Lots Avenue" or "Flatbush Avenue," to Eastern Parkway-Brooklyn Museum Station.

I.R.T., East Side (Lexington Avenue line), downtown express marked "New Lots Avenue" or "Utica Avenue" or "Atlantic Avenue," to Nevins Street; step across platform and change to 7th Avenue or Broadway-7th Avenue train, ride to Eastern Parkway-Brooklyn Museum Station.

B.M.T., Brighton Beach line, downtown express or local to Prospect Park Station.

By AUTOMOBILE:

From Long Island, take Eastern Parkway westward, and turn left at Washington Avenue.

From Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway; follow the Parkway to Washington Avenue, then turn right.

BROOKLYN BOTANIC GARDEN RECORD

PLANTS & GARDENS

SUMMER
1951

Garden Paths

Lapland
Magnificent

Lawns

Chrysanthemum
Magic

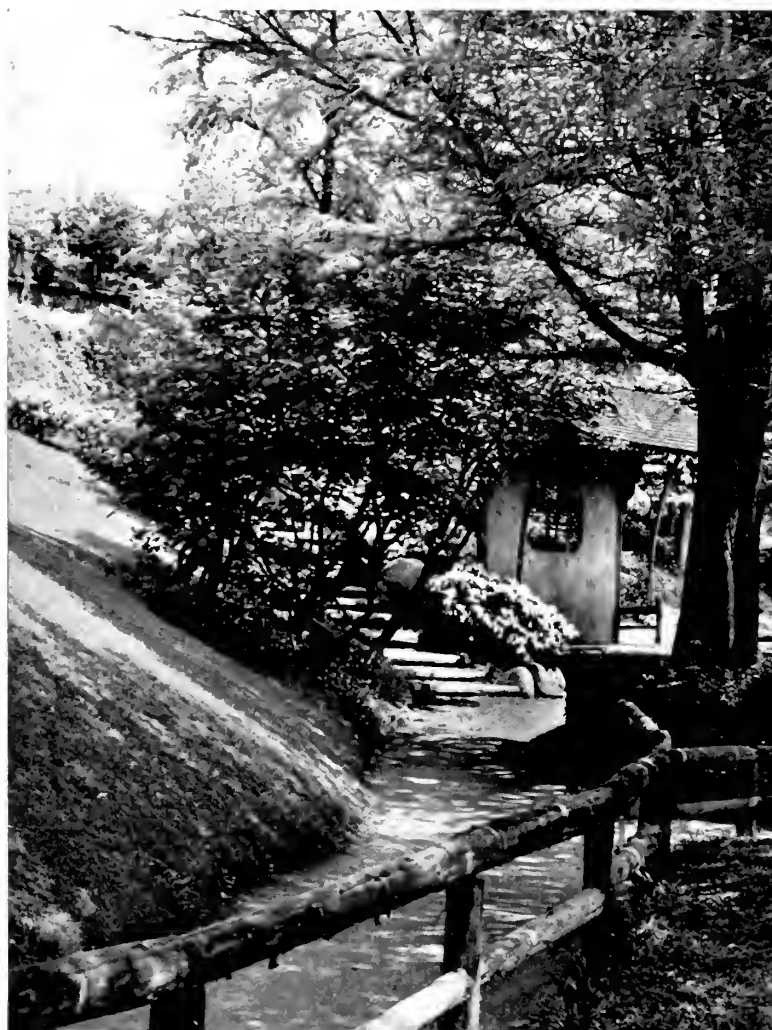
Sequoias for
Cultivation

Diseases that
Kill Trees

NEW SERIES

VOL. 7

NO. 2



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*Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture.



PLANTS & GARDENS

Toringo Crab Apple (*Malus sieboldi arborescens*)

VOL. 7

Summer, 1951

No. 2

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This issue compiled by the Editorial Committee of the Brooklyn Botanic Garden
HESTER M. RUSK, *Assistant Editor*

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THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES
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Summer 1951

Nearly every issue of PLANTS & GARDENS is built around a special idea, as most readers have long since discovered. For example, in the past year, we've brought you four easy-to-read little books: Flowering Trees, Flowering Shrubs, Herbs, and an issue that featured dwarf trees as the Japanese grow them.

Once in a while we have to catch up on general things that amateur horticulturists and above-average gardeners want to know, and that explains this summer number of 100 pages — which starts with ideas for garden paths and ends on gas injury to trees. In between these two articles we are proud to present:

Redwoods and giant sequoias. Why not grow them outside California, as a few people in the know are already doing?

Lawns, a subject every ambitious gardener wants to master; now is the time to start.

A dozen articles on the really serious tree diseases in America — the killers — and what can be done about them.

Overnight magic with chrysanthemums. Is there a spot where your lawn satisfies every need until autumn — but then you would like a small chrysanthemum garden, in a hurry, for a few weeks of pleasing autumn color?

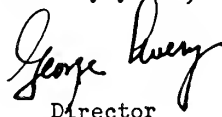
Lapland and the earth's northernmost gardens. Beyond the Arctic Circle is a motherland of dwarf plants that you may enjoy knowing more about. For me it was an out-of-this-world experience, and I hope the story will bring pleasure to others who like unusual plants, and far-away places.

Grafting and rooting, an intriguing subject for every horticulturist, amateur or professional. And when all the books — and experience — say you can't root a certain kind of cutting, a new and special technique may turn the trick. The new technique comes from a South African researcher, and this is the first time it has been published.

There are a half-dozen other articles touching as many different subjects, all for your information and enjoyment.

The autumn issue will be on growing fruits in the home garden; Guest Editor George Slate has a splendid issue in store for you!

Sincerely yours,


Director

SAVE WEDNESDAY EVENING, OCTOBER 17th: ANNUAL MEETING FOR MEMBERS,
AT THE GARDEN.

← Elizabethan Knot Garden in the Herb Garden of the Brooklyn Botanic Garden

Except where otherwise credited, photographs by Louis Buhle

Garden Paths

Planning, building, and planting

Alice Recknagel Ireys

ONE of the most interesting features of garden design is an attractive path; it adds charm and variety to even the smallest garden. The accompanying pictures illustrate types of paths and appropriate plantings for them.

The illustration in color, inserted at the center of this issue, gives a particularly vivid impression of a practical path, well planned and attractively planted.

A path should be located primarily for convenience—and then it usually looks well. It must lead somewhere, and interesting pictures should be built up to tempt the visitor along. The width of a garden path depends upon its length and its use; it must be at least 2 feet and may be as much as the design calls for, even up to 10 or 12 feet.

The choice of surface material depends upon the type of path and its situation. For a woodland garden, pine needles or tan bark may be used and bordered with small ferns and wild flowers. Grass is lovely to look at but will not stand heavy wear. Gravel paths are nice if careful upkeep can be given to maintain them in good order. Paved paths of brick or stone are always good provided they are properly constructed.

Should the garden path have an edging? The answer is "yes" for a grass or gravel walk. Bricks set on end, granite blocks, and an inconspicuous steel edging are a few of the types that may be used to keep the boundary of the path.

Construction

A path may easily be constructed with the use of a steel tape and plenty of small stakes or markers. After its course has been carefully staked on the ground, the necessary amount of excavating is done; a depth of 6 inches is usually enough, provided the drainage is adequate. This space is packed with porous material, stone, coarse gravel, cinders, or ashes; upon this well firmed base is spread a layer of sand. Brick or stone may be laid dry or with mortar.

The making of a perfect brick walk requires careful laying, but this can be done by amateurs if enough time is taken. Brick of any desired color may be used, but hard-burned brick should always be obtained, as the soft kind is apt to crumble from absorbing water and freezing. The bricks should be set along the edge first, then the selected pattern laid, and sand brushed into the joints.

The path must be sloped so that water will not stand on the surface; it is generally advisable to slope a narrow path in only one direction. Patterns of brick are numerous; but whether the good old-fashioned basket weave or a made-up design is used, thorough tamping of the cinder or gravel base is necessary for a firm finished surface.

Plants

Now is a good time to study the path problem, decide on the location, and make plans for fall work. The plant material that lines the walk must be carefully considered; the path may be gardenesque in character, with clumps of lilacs and low-growing perennials; or formal, with rows of box and flowering dogwoods. It



McFarland

Closely laid flagstones make this path practical and easy to maintain. Azaleas and rhododendrons screen the adjacent driveway, while ferns and other shade plants give an informal effect.

may wind through pine woodlands with plantings of azaleas and rhododendrons or wander down to a pool with groupings of shadbush, blueberry, and laurel.

The path should lead to a goal in a leisurely and pleasant way. Colors that contrast with the setting are to be avoided, and the path should harmonize with the other architectural features of the

grounds. Rough stones that would catch high heels should be avoided; the result should be comfortable to the foot and unobtrusive to the eye.

A good path serves comfort and convenience. Each situation calls for individual consideration, but the garden path should be planned so as to add charm to the garden design.



Gottschow-Schleisner

Irregular flagstones and grass joints are particularly suitable for this path to the pond. Primroses, globeflowers, and squills are among the spring blooming plants making a carpet of color under the flowering cherries and birches.



Gottschalk Schleisner

This substantial flagstone walk leads through the perennial garden. In midsummer, lilies, delphiniums, and phlox form a background for the lower growing Tussock bellflower, coral bells, and *Nepeta*. The flagstones are laid with ample space between them for sowing grass. And of course the grass is mowed and clipped as needed.



Gottschö-Schleisner

Important elements in this picture are the lawn, the herringbone brick walk, steps, and gate beyond. Graceful birches, flowering shrubs, and yews are the attractions along the path, with *Nepeta*, candytuft, lilies, and potted fuchsias.



Gottsch-Schleisner

Brick walk, leading past fragrant madonna lilies and under overhanging white-barked birches, ends at low stone walls which mark the boundary of the formal garden.



Richard Averill Smith

Plantain lilies make a suitable border for this grass path in partial shade. Irises, foxgloves, and poppies provide a riot of color in June.



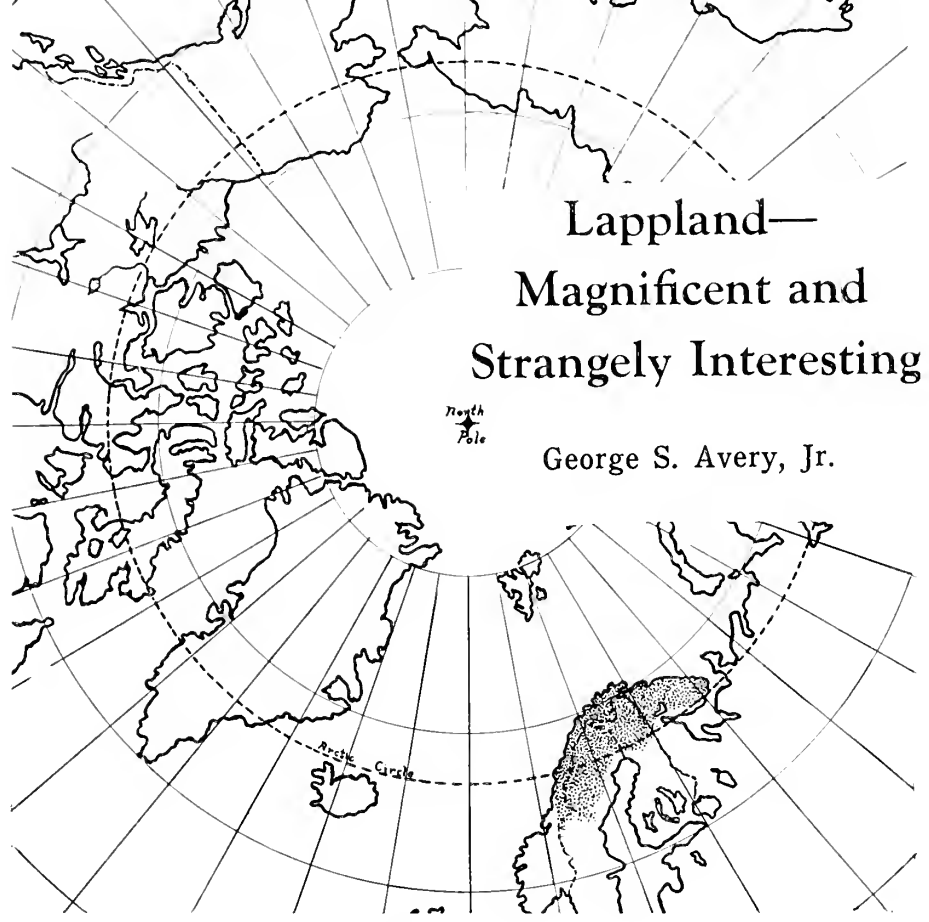
Gottschew-Schleisner

The long blooming season of pansies makes them a desirable edging for a walk. This informal grass path is not too much shaded, although it goes among pines and oaks and is bordered with lilacs and dogwood. Delphiniums, lilies, and phlox are coming up for later bloom.



Author photos

Arctic diaspensia (*Diapensia lapponica*) is one of Lapland's cushion plants. Its deep green, heavily matted foliage and milky-white flowers make almost every mountain a veritable rock garden.



Lapland— Magnificent and Strangely Interesting

George S. Avery, Jr.

*Tulips to dahlias—simultaneous
bloom in the world's northern-
most gardens*

EVERYONE who knows or enjoys the earth's vegetation likes to walk in a forest. To walk *on* the forests, go to the mountains of northern Lapland, a little over a thousand miles from the North Pole. On mountain meadows fully grown willows generations old are but an inch or two in height—and form carpets as soft and inviting to step on as the grass of a fine lawn. On mountain tops century-old dwarf birches cling closer to the rocks than the rock spray (*Cotoneaster*) planted in American gardens.

Just where is this unusual country, and what kind of climate has produced such forests?

Location

Lapland has no geographic borders; it is not a country in the ordinary sense. The northern fourth of the Scandinavian Peninsula, where Norway, Sweden, and Finland meet, is the heart of Lapland—some 15,000 square miles of it, partly forested, and partly semipolar waste. The world's thirty thousand Lapps live chiefly in these three countries; fewer than two thousand live inside the Russian border. Lapland is beyond the Arctic Circle, which means that its latitude is comparable to that of the middle third of Greenland or the northern half of Alaska. (Iceland is entirely south of the Arctic Circle.)

Climate

In this land of the midnight sun there is continuous daylight for some ten weeks



At lower elevations there are occasional bogs, and trees may be as much as 10 to 15 feet tall

in the summer, yet the temperature seldom goes above 60°F. During June, July, and much of August the valleys and mountainsides are wet from melting snow, green with vegetation. But for nine months of the year it is a frozen land; snow-covered mountains are everywhere.

To appreciate its present climate one must recall that except for some of the higher mountain peaks, all inland Scandinavia was covered for thousands of years with a great ice sheet that persisted until about seven thousand years ago. Actually, the difference between the Ice Age climate and that of the present is not very great. We are told that if the average temperature in Lappland were to drop only about 15° F., it would mean a return to the Ice Age; great glaciers would again begin to form. This being the case, one could hardly expect more than just what one finds—snow fields throughout the mountains, which melt for a few weeks in midsummer but never disappear.

The People

We have no way of knowing when the

early Lapps migrated from inner Asia to Lappland, for there was no written Lappish language until three to four hundred years ago. But records show that the Scandinavians have traded with the Lapps for at least fifteen centuries; so, for probably two thousand years or more the Lapps have occupied the same magnificent but desolate mountain country. Thirty thousand Lapps in some fifteen thousand square miles is perhaps as dense a population as could be expected in a semipolar waste region that is all but uninhabitable, yet nowhere else on earth do so many people live so far north. The Lappish language is related to those spoken along the Arctic coast of European Russia and western Siberia; and though it is perhaps nearer to Finnish than any other, the Lapps and Finns cannot understand one another.

In Swedish Lappland there are no highways, no motor cars; and if there were, there would be almost no one to use them; but the iron ore from the Kiruna mines is important enough to justify a railroad. Thanks to the Kiruna ore, one can go nearer the North Pole by rail in Swedish



Snow fields are everywhere, even in midsummer; they melt slowly, but never disappear; mountainsides are often wet under foot. Many are the mountain brooks, and lakes are not uncommon

Lapland than anywhere else in the world.

Wild Plants

In all the Scandinavian Peninsula there are some two thousand kinds of flowering plants that grow in the wild. In northern Lapland this number is reduced to only about two hundred and fifty, and most are perennials. They bloom from the time the snow begins to melt in late May until the frosts come the third week in August; the season is hardly long enough for annuals to grow, flower, and produce seed. One of the exceptions, an annual, is a gentian (*Gentiana nivalis*). Of the herbaceous perennials, the glacial buttercup (*Ranunculus glacialis*) is one of the loveliest; to discover a lone specimen poking its flowers up between boulders or along the edge of a snow field near the top of a five-thousand-foot mountain is not unusual. Other genera of herbaceous perennials (species mostly unfamiliar) are *Campanula*, *Geranium*, *Potentilla*, fireweed (*Epilobium*), hawkweed (*Hieracium*), goldenrod, chickweed, and saxifrage.

Among the dwarf shrubs is the Lapland rhododendron (*R. lapponicum*). It blooms in June, and is the only species of rhododendron that grows so far north. It grows only on calcareous, approximately neutral soil.* Other dwarf shrubs that are also more or less familiar in our Western Hemisphere are arctic white-heather (*Cassiope tetragona*), ground birch (*Betula nana*), mountain avens, sometimes called "arctic-rose" (*Dryas octopetala*), mountain-heath (*Phyllodoce caerulea*), alpine azalea (*Loisleuria procumbens*), alpine crowberry (*Empetrum hermaphroditum*), bog-rosemary (*Andromeda polifolia*), black bearberry (*Arctostaphylos alpina*), and some of the dwarf blueberries (*Vaccinium myrtillus* and *V. uliginosum*).

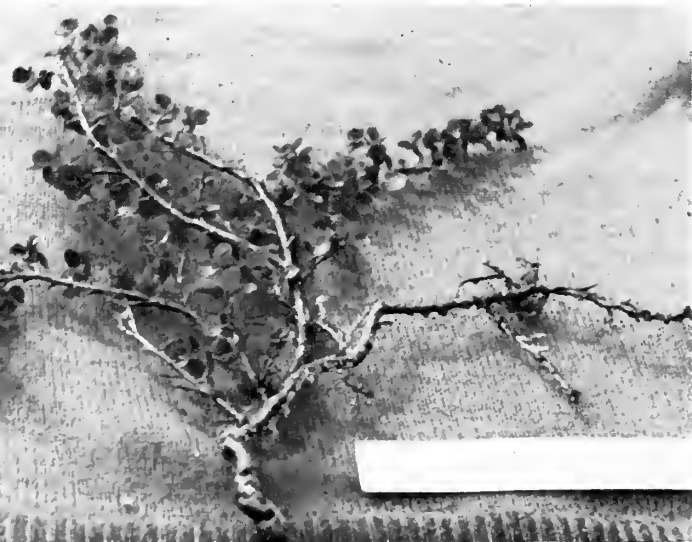
Lapland, like most of the Arctic, is a motherland of dwarf trees and shrubs. To grow above the winter snow is to die, and thus it is that the dwarfs have been successful. High in the mountains the forests are like lawns, or low compact-

*This same species grows on acid soil on New Hampshire's famed Mt. Washington.



Buttercups prosper beside boulders or patches of snow. This is the glacial buttercup (*Ranunculus glacialis*)

growing ground covers. There are only five kinds of familiar trees that succeed in that rigorous climate. In the lower valleys they are treelike, but a few hundred feet up a mountainside they are dwarfs, or drop out altogether. Three of them are well known in the United States: mountain-ash (*Sorbus aucuparia*), Norway spruce (*Picea abies*), and Scots pine (*Pinus sylvestris*); the others are a gray birch (*Betula tortuosa*) and two kinds of willow.



Century-old dwarf birches grow flat on the rocks at higher elevations. This one had a sweater under it—just for the picture

Farms and Gardens

The northern limit of agriculture in Lappland goes far beyond that of our own hemisphere; an occasional potato patch is not uncommon in Lapp villages more than a hundred miles north of the Circle. Rye and barley can also be grown.

Readers may have wondered, as I have, how far north one finds ornamental plants—i.e., how far north do people garden? Lappland gave the answer. A hundred miles north of the Arctic Circle in the famous Swedish ore town of Kiruna, there are a few private gardens and an attractive little park. In the park and gardens on the last day of July there were tulips, columbines, petunias, asters, chrysanthemums, and dahlias—all in full bloom, a midsummer galaxy. In the eight frost-free weeks of continuous daylight, apparently everything blooms at once or not at all.

Typical Days

It was with a scientific expedition (following the 1950 Stockholm International Botanical Congress) that I went to Lappland. There were more than a hundred of us, from twenty-three different countries. In the tiny village of Abisko we

were taken care of simply but happily in the school—and a variety of other places. For botanical exploration, we generally started westward each morning on the 9:26 train from Abisko, and went to station stops with such Lappish names as Katterjokk and Vassijaure or Swedish names as Björkliden and Kopparåsen. We climbed mountains called Nuolja, Ljutatjärro, and Låktatjåkko. Our constant companions were the over-sized mosquitoes—and unlucky was the man who forgot to carry his little bottle of mosquito oil.

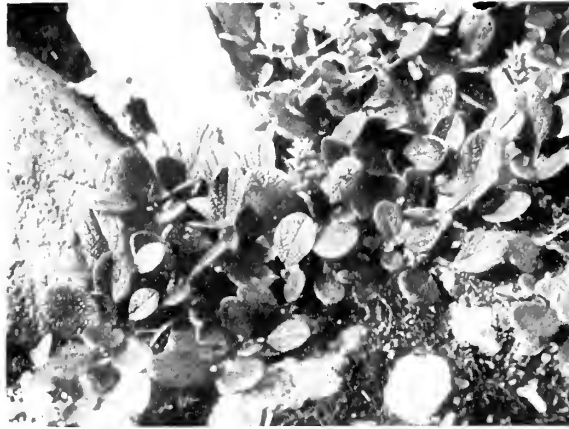
Here are a few typical diary entries:

"July 24: almost atop Kopparåsen. Mostly barren rock areas higher up; stopped for lunch by magnificent small mountain lake and glacier. The only frequently occurring plants in the adjacent meadow are arctic willow, arctic rose, and star saxifrage."

"July 25: by rail to Björkliden. The party stayed together as far as Fjället Inn. A charming spot; view from huge dining room window down Lake Torne-träsk. Party divided at Inn, and seventeen of us went to one of the higher peaks of Kappastjärro. Lunch at 1050 meters (3465 feet) by rocky ledge for wind protection. Glacial buttercup along border of melting snow field; Lappland rhododendron; one spot of at least an acre of arctic rose."

"August 1: atop Låktatjåkko. Reindeer clearly visible on snow fields; saw eight of the twenty-five different kinds of flowering plants that are known in the high alpine zone."

If I were some day to return to Lappland, and there were no scientific expedition, it would be pleasant to stay at the Fjället Inn, a few hundred feet up the mountain from Björkliden. It is about twenty-four hours from Stockholm by rail and perhaps 150 miles north of the Arctic Circle. The midnight sun is visible for a few weeks in June and July. The nomadic Lapps often can be seen herding their reindeer in summer mountain pastures. For a never-to-be-forgot-



Clair Brown photo

This very dwarf reticulate willow (*Salix reticulata*) and two other equally diminutive willows (*S. herbacea* and *S. polaris*) make up probably the most intriguing forests of dwarf trees to be found in all of Lappland. They form carpets as soft and inviting to step on as the grass of a fine lawn

ten experience, take the easy "trek" by rail to the land of a primitive people, magnificent mountains, dwarf vegetation, and arctic quiet.

Dwarf dogwood is common (*Cornus suecica*)

Author photos





Common along one of the trails leading up Låktatjåkko is cotton grass (*Eriophorum*)

Small mountain lake is fed by melting snow field





With fireweed and other wild flowers on walls and roof, this turf-covered Lapp home is gayer than it looks

Acknowledgment and addendum for those who know plants well: It is a pleasure to express my appreciation to Professor Einar Du Rietz of the University of Uppsala, who led the 1950 Plant Geographic Expedition to Lappland. In checking the accuracy of the manuscript for this semipopular report, he has been kind enough to remind me that by arctic standards, there is still another tree in Swedish Lappland. It is the common speckled alder (*Alnus incana*), found frequently along streams and around bogs in many parts of the United States. He also recalls that the two kinds of willow (mentioned on page 80) that come close to having tree stature at lower altitudes in the Arctic are *Salix borealis* and *S. caprea*.

G. S. A., JR.

Except for the summer in the mountains (to avoid "heat" and insects), reindeer spend the year near Lapp villages in the lower valleys

Wästfelt photo





Lawns

How to make and care for them

Joseph Ryan

SO many factors enter into lawn making that it is not always easy to suggest a single plan of procedure. Let us take up, one at a time, some of the problems.

Making a New Lawn

If one is to build a new home, the program is quite simple. If the topsoil is of good quality, it should be removed from the area where the cellar is to be excavated, and placed at one side of the building operations. This is comparatively inexpensive and well worth while. After the house is completed and the subgrade established, the topsoil is to be returned. Some form of organic material should be added, such as well rotted manure, spent mushroom soil, peat moss, or compost. The amount of such material needed depends partly on the quality of the topsoil, and partly on the organic material chosen. If mushroom soil is used, 2 to 3 inches should be well worked into the top 4 inches of soil; if manure or peat, half that amount is sufficient. The important part of the operation is working the material in well, for the future moisture-holding capacity of the soil depends largely upon the presence of organic matter. The time to put this in is in the beginning. Layers of any kind should be avoided, whether sand, organic matter, or clay. If lime is required, about 50 pounds of finely ground limestone per

1000 square feet should be applied at this time.

In the northeastern states phosphorus is usually low, and raw bone meal or superphosphate (40 to 50 pounds per 1000 square feet) will correct this condition. As it is difficult for phosphorus to penetrate established turf, it should be applied when it can be worked in with the other materials.

To produce a rapid growth in newly seeded areas, it is well to apply a complete fertilizer (20 pounds per 1000 square feet) a few days prior to seeding. This must be well mixed to a depth of 1½ inches.

Before seeding, the soil must be raked and rolled several times, to remove stones, clods, and other refuse, and to eliminate all pockets. This is very important, as the soil must be thoroughly pulverized to insure good germination.

Conditions will determine the type of seed to plant. While Kentucky bluegrass is as near a perfect lawn grass as we know, it is useless to plant it if the homeowner wishes to keep a closely clipped lawn (½ inch). The grass mixture one plants will in no way determine what particular kind of grass will predominate after a few years of cutting. It is usually a case of the survival of the fittest. It sometimes happens that 5 or 10 per cent of one kind of seed in a mixture takes over completely. I mention this to show that the choice of seed combination is not always the important factor in the establishment of a certain type of grass.

Let us assume that one selects a combination consisting of Kentucky blue-grass 50 per cent (by weight), redtop 15 per cent, *Poa trivialis* 10 per cent, Chewings fescue 15 per cent, colonial bent 10 per cent. From that selection one should develop a good lawn, but the maintenance of the lawn will influence the growth of the various kinds of grass. If one cuts such a lawn at 1½ inches, and if there is not too much shade, one should have a blue-grass lawn. On the other hand, where close cutting is carried out it usually turns out to be crab-grass—self-sown. However, Merion blue-grass (B27) is good to use in any seed mixture, as it will definitely stand close cutting.

Pennsylvania State College has developed several strains of fescue that show great promise.

The amount of seed needed varies with the choice of combinations. Where no clover is used, and not over 25 per cent of fescue, 5 pounds per 1000 square feet should be sufficient. Of the two evils—too much seed or too little—the former is likely to cause more trouble, as sufficient space must be allowed for the development of the plants. If the plants come up too thickly, they choke each other and fail to develop healthy root systems. On the other hand, if too little seed is used, weeds have a better opportunity to develop.

Remaking a Poor Lawn

Many lawns are built on whatever soil happens to be available. Often such lawns are fertilized and seeded every year and are still disappointing. It is poor policy to try to remedy the condition by any method of maintenance. The most economical way is to begin over with bare soil. All plants should be removed in July or the early part of August; then most of the weeds will be eliminated, and sufficient time will still be available for reseeding not later than September 1.

Organic material should be applied, the same kind as for a new lawn but double the quantity. It should be worked into

the soil with a disc or rototiller, if possible; but if necessary, it may be spaded in. Above all, the mixing must be well done; the soil should be worked over several times so that the extra material will be thoroughly incorporated. Where heavy clay is found, sand should be added to the mixture. The rest of the program of seed bed preparation and seeding is the same as for the new lawn.

Reconditioning a Weedy Lawn

The most important decision to be made, when improvements of the lawn are being planned, is the season of the year for the work to be done. Where crab-grass is a problem, reseeding in the spring is, for the most part, no remedy. The best one can hope for is temporary relief. A fall program is best for any weed-infested lawn. The program must be well planned, with all needed materials on hand, so that the work can be done when conditions are favorable—usually about the last of August. First the lawn is mowed as closely as possible, and a grass catcher is used; then the weed runners are raked up from all directions, and the lawn is mowed again. This is done as often as necessary to remove all the seed heads. The soil is tested for lime requirements, and ground limestone applied accordingly. Later a complete fertilizer is applied, 30 to 40 pounds per 1000 square feet. A spiked roller helps get the fertilizer into the ground without disturbing the existing grass; but if no such tool is available, a steel rake may be used. The fertilizer is put on when the grass is dry, and watered in thoroughly to prevent burning.

Conditions will determine the type of seed to be used, but in general a grass mixture will give the best results. The best seed obtainable should be bought—from a reputable seed house. It will germinate faster and better if it is lightly covered with screened topsoil or compost that is free from weed seed, then rolled lightly, and kept moist but not flooded.

A program carried out in this manner should develop a solid stand of turf by



The coarse-textured hairy crab-grass spreading in a lawn

the time winter sets in, which should be dense enough to keep crab-grass in check the following season.

General Care of Lawns

Whoever first said "an ounce of prevention is worth a pound of cure" was probably thinking of his lawn. If a lawn is allowed to run down, it is always more expensive to get back into condition than if it had been properly cared for. Most lawns are not mowed often enough, and the mower is usually set too close. This is especially true in the spring and early summer when the growth is heavy. At such times, mowing only once a week necessitates the use of a grass catcher. This removal of the cuttings tends to deplete the soil of the necessary elements for the growth of the grass. Often the mower is not kept sharp or is not adjusted properly. Grass that is clipped off cleanly grows well; but if it is dragged through the mower, the tips are bruised and the growth hindered. A sharp mower means a clean-cut lawn.

Some lawns are watered too much, and some not enough. A lawn should never be allowed to dry out so that the grass becomes wilted. A good soaking, when needed, is far better than a light sprinkling every day or two. Sprinkling

stimulates weeds, and leads the grass to develop a shallow root system.

Rolling should be necessary only in the spring. The purpose is to eliminate air pockets resulting from frost heaving, and to bring the grass roots into close contact with the soil. Rolling should be done neither when the ground is wet, nor when it is dry and hard.

The most important part of lawn care is the fertilizing program. Fertilizing should be done in the fall and in the spring; fall is the best time for a heavy application. It is a good practice to vary the analysis; that is, to use more of one element one year and more of another the next; 20 to 40 pounds of complete fertilizer per 1000 square feet may safely be used in the fall, but not over 25 pounds in the spring. Fall application of fertilizer may be made in September in the central and eastern states, spring application in early April.

Faithful attention, season after season, is necessary to build up a good turf; but when the work becomes an established part of the garden routine, the actual time and effort involved are not so great as to become a burden.

[Other articles on lawns appeared in PLANTS & GARDENS, Summer, 1947, and Winter, 1948.—ED.]

The Basket-flower

Reliable for summer bloom

Gertrude M. Smith



McFarland

ONE of the most dependable of the tender summer-flowering bulbs is the basket-flower, or Peruvian-daffodil (*Hymenocallis calathina*, often listed as *Ismene calathina*). This native of the Andes in South America must have a rich, well drained soil and plenty of sunlight; given these, it is very easy to grow. It is showy when planted in groups, in front of shrubs or in the perennial border.

Planting

The large bulbs are planted 12 to 18 inches apart when the weather becomes settled in the spring. The holes must be large enough to accommodate any roots which are on the bulbs. It is necessary to have only 2 or 3 inches of soil over the top of the bulb.

The plants grow quickly once they have sprouted, soon producing stalks 2 to 3 feet high topped by large fragrant white flowers. The flower is rather unusual in form. The center part is a lilylike crown about 4 inches across, which emerges from a circle of narrow petal-like segments. The straplike leaves, which attain a length of about 18 inches, remain a fresh bright green until they are withered by frost. It is important for these leaves to get plenty of sun so that flower buds may be formed for the next season.

Digging and Storage

In digging the bulbs after the first frost, care must be taken to bring up the fleshy roots still attached to them; if these are torn away, the bulbs are useless. The basket-flower must be stored in a fairly warm place—an advantage in these

days of cellars too warm for dahlias. A storage temperature under 40° F. destroys the flower buds, though the bulb will still grow and produce leaves the following spring.

This is a plant which seems to have no diseases or insect pests. It increases well, but the bulbs should not be torn apart until they are ready to divide easily.

As a Pot Plant

The basket-flower can be used also as a pot plant. If it is used in this way, it must complete the same cycle of growth and rest as when grown outdoors. It should be planted in a pot 10 or 12 inches across, to accommodate the roots. After the flowering period is over, the plant must be kept watered so that the foliage will stay fresh and green until its work of storing food in the bulb is completed.

When the foliage begins to turn yellow, watering should be gradually stopped. When the plant has dried off, the pot may be set away in a dark place (with the bulb still in it) until the next year. Repotting is not needed for two or three years. Good sunlight is needed for bloom throughout the growing period, in a pot as well as in a flower bed.

Three Hybrid Lilies

*HURRICANE, TYPHOON,
and SPITFIRE*

Percy H. Wright

THE original cross that produced the STENOGRAPHER lilies, made by Miss Isabella Preston at the Central Experimental Farm at Ottawa, Quebec, Canada, combined two very diverse kinds of lilies. *Lilium willmottiae* was the seed

parent, and the pollen came from a seedling of a candlestick lily, or *L. dauricum* type. This is a cross between a lily of the turkscap group (the seed parent) and one of the erect-flowered group, and represents a hybridization that might easily have been regarded as impossible.

The first generation from this cross included numerous seedling varieties varying comparatively little among themselves, in general intermediate between the two parental types, with outward-facing or somewhat pendent flowers.

When seedlings were grown from these first-generation hybrids, much greater variation appeared, including reversions to the erect flower of the candlestick type. Among these are three varieties, TYPHOON, SPITFIRE, and HURRICANE, which were named after the various types of aircraft used in the Battle of Britain during the Second World War. Here are the descriptions as they appear in "Garden Lilies," by Alan and Esther Macneil:

"HURRICANE has upright-facing blooms with the inflorescence arranged like a candelabrum. The flowers are vase-shaped, and a brilliant dark red in color. SPITFIRE* is identical with HURRICANE in habit, and has blooms that are flame-scarlet, with some medium-sized bay spots. It is a handsome and prolific plant of easy culture. TYPHOON has a mass of upward-facing, brilliantly colored, orange-red flowers arranged in a close head."

*A photo of this lily appeared in PLANTS & GARDENS, Summer, 1950, page 95.—Ed.

Lily HURRICANE

McFarland





Courtesy of F. L. Skinner

Lilium willmottiae, seed parent of these three hybrids

At my place near Moose Range, Saskatchewan, Canada, I have grown these three lilies for some five years, and have not noticed any susceptibility to virus disease. However, they have proved to be somewhat less well adapted to my

Lily TYPHOON

R. A. Brown

high-lime soil than the STENOGRAPHER lilies from which they are descended, or at least they are less vigorous in growth. Further color variations have since appeared in the upright-flowered seedlings, and so the three varieties named must be regarded as merely the beginning of new things in the erect-flowered group of lilies. In general, these erect-flowered lilies with an infusion of the characteristics of *L. willmottiae* in their constitution are much less coarse in habit and texture than the other lilies of the candlestick type.



How to Force Lilies

Guideposts for the amateur, for fall and winter

Norma E. Pfeiffer

ALTHOUGH many persons grow spring-flowering bulbs in pots for early flowering, it is less generally known that certain kinds of lilies perform almost as readily under this treatment. Especially recommended are the Easter lily (*Lilium longiflorum*), the goldband lily (*Lilium auratum*), and the showy Japanese lily (*Lilium speciosum*), which can be grown at slightly warmer temperatures (55° to 60° F. at night) than the equally desirable madonna lily (*Lilium candidum*); this one grows better, at least until flower buds show, at 50° F. The small greenhouse or cool sun porch or alcove, where temperature can be controlled, presents proper conditions for the active growing stages of these lilies. Several other kinds have grown well in the winter (in our experience), including *Lilium henryi*, the coral lily (*Lilium pumilum*), *Lilium formosanum*, and *Lilium myriophyllum superbum*. The last resembles the madonna lily in requiring a cool house.

Potting

Healthy bulbs acquired in the fall are usually grown singly in 5- to 6-inch pots, or larger ones, depending on the size of the bulb. The 5- to 6-inch pots are adequate for the average varieties of Easter lily, or for a group of three to six bulbs of the coral lily or the star lily (*Lilium concolor*). Large pots are suitable for

large bulbs of the estate lily (a variety of Easter lily) and *Lilium henryi*, which grow to a greater height.

Two requirements in culture should be stressed: good drainage and careful watering. The former may be assured by having a 1-inch layer of broken crockery or charcoal in the bottom of the pot, adding enough sand to give a gritty effect to the soil mixture, and putting a layer of coarse sand immediately around and below the bulb. The soil mixture, to which the sand is to be added, may be made of approximately equal parts of garden soil and peat moss or hardwood leaf mold. The depth of the soil put into the pot (before the bulb is placed) is determined by the type of lily. All of the kinds mentioned above, except the madonna lily, produce roots on the stem immediately above the bulb, in addition to the first roots at the base of the bulb. To take advantage of these extra roots, it is well to plant such bulbs relatively deep in the pot, possibly with only an inch or so of moist soil, upon which the sand layer is then placed before the bulb is set. The madonna lily and its hybrid the Nankeen lily (*Lilium testaceum*) should have shallow planting, only an inch below the soil surface. Whether the bulb is planted shallow or deep, the pot is finally filled with moist soil to within $\frac{1}{2}$ inch of the rim.

Forcing Schedule

In order to allow growth of roots, pots are put in a convenient dark cool place: sunk in sand or peat in a frame, or in a sheltered position in the garden where light soil can be filled in about them, or even in a cool cellar (40° to 50° F.).

Freezing is to be avoided, and the pots should not dry out.

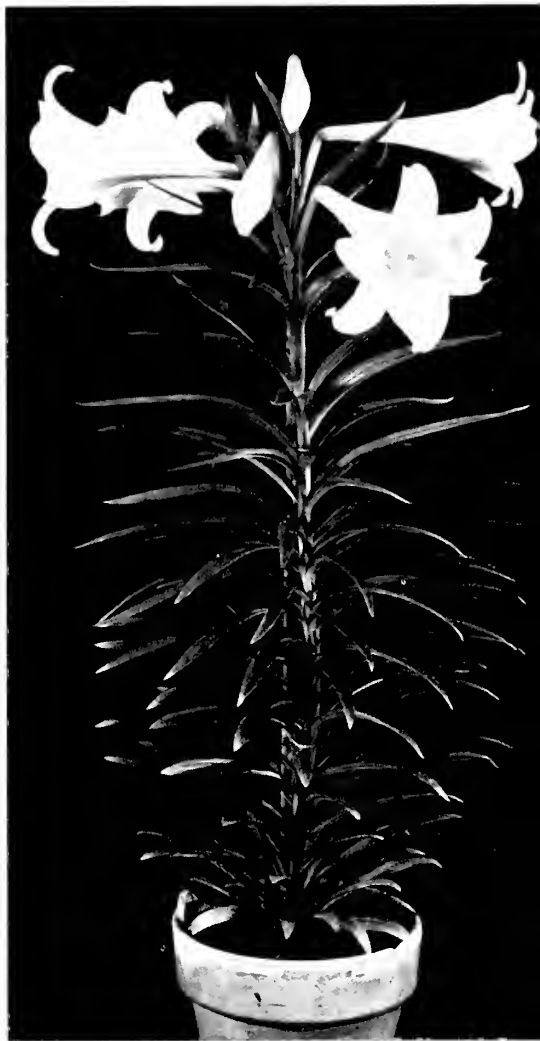
With most kinds of lilies, pots of bulbs may be brought into the greenhouse any time after late December or early January. Madonna lilies, usually received earlier and rooting as quickly, may be ready even sooner. One may obtain a succession of bloom by bringing in pots at two-week intervals. In the greenhouse the shoots will emerge from the soil within a few days to a few weeks; there is variation in rate of growth among different kinds of lilies. Too rapid early growth is a disadvantage; this can be controlled by avoiding too high temperature in the beginning. Stronger plants result, also, if a commercial fertilizer is used in moderation at ten-day intervals from the time the shoots are a few inches high until flower buds are well developed. Moderation in watering is also recommended. During growth, spraying or fumigating with nicotine controls aphids which might spread disease.

Saving the Bulbs

After enjoying the beauty of the blossoms, the amateur grower or the recipient of a lily flowering in a pot in early spring faces the problem of saving the bulb. After blooming, the plant should continue growing (with reduced watering) until the foliage matures (turns yellow). It may be kept either indoors, or in a sheltered spot outdoors if the weather is clement. With the yellowing of the leaves, possibly in late June for April-flowering Croft lilies, or in early fall for regal lilies (*Lilium regale*), the stems may be cut back and the bulbs planted in the garden. It is usually recommended that bulbs be given a few seasons outdoors before again growing in pots for early blooming, although this is not always essential.

Avoiding Disease

In some kinds of lilies it is difficult to avoid disease except when the bulbs are raised from seed; and so bulbs which are propagated otherwise should be segregated from any other lilies that may be in the garden, unless the latter are known



Courtesy of Boyce Thompson Institute

Easter lily (*Lilium longiflorum*) flowering in a pot in a greenhouse on March 16; bulb grown from seed

to be disease resistant. Starting with healthy stock, and using the proper precaution to prevent the spread of any infection that may creep in, one should have no difficulty in forcing lily bulbs for early bloom.*

*Other articles on lilies appeared in *PLANTS & GARDENS* in the autumn of 1946 and 1947, and in the summer of 1949 and 1950.—Ed.



Courtesy of U.S.D.A. Soil Conservation Service

Shipmast locust trees along waterfront near Oyster Bay, Long Island

The Shipmast Locust

A variety of the black locust

Henry T. Skinner

THE black locust (*Robinia pseudo-acacia*) has much to recommend it as an ornamental. It is a picturesque tree peculiarly adaptable for dry hillside locations and poor soils, and its clusters of white pealike flowers are borne profusely in mid-May. Like most other members of the legume family, its roots are equipped with those curious little nodules which enrich the soil by putting atmospheric nitrogen into compounds that plants can use.

Importance

It is from an economic point of view that black locust is outstanding among trees of its type. Since Colonial days the wood of this American native has been used in vast quantity for fence posts, door sills, and similar purposes where durability in contact with the soil is an important factor. In more recent years its growth qualities as a pioneer in different situations have firmly established its value in practices directed toward the conservation of our disappearing soils.

Discovery

From the earliest days, farmers cutting black locust for fence posts repeatedly noticed that the trees were not all quite alike. In one district trees might be many-branched and crooked, producing few straight posts; in another, or perhaps intermingled with the branching trees, nice straight individuals were found, with a single main stem which made excellent lumber. Again, the wood of some individuals lasted extremely well in contact with the soil while that of others was much less durable. This char-

acteristic became associated with the color of the wood; trees producing good yellow wood were used by the knowing farmer in preference to those with wood of lighter or grayish brown color. In such manner a number of different strains or forms of the black locust became recognized; one of the most distinctive of these, an upright type with extremely durable wood, has been given the name of shipmast locust (*Robinia pseudo-acacia rectissima*).

The story goes that Captain John Sands, a seafaring Englishman, built a house at Sands Point on Long Island in 1668. On a coastwise trading trip to Virginia, repairs were needed to his ship and the wood of a native locust was found to be both strong and useful. On a subsequent trip Captain Sands took plants of this locust to his home on Long Island; a supposed original of these plants is still to be seen growing at the Washington Tavern at Roslyn. This particular locust has not been rediscovered in Virginia; but the farmers and land-owners of Long Island have propagated it by root suckers until it has become one of the commonest trees of the terminal moraine soils radiating from Oyster Bay. The interest of the farmers was in fence posts. The common black locust already grew on Long Island; but whereas the wood of these trees lasted about twenty-five years in the soil, fence posts from John Sands' locust (the shipmast, as we know it now) lasted upwards of fifty years in remarkably good condition. There are actual records of posts from shipmast locust fences 110 years old being resold for further use at a price of fifty cents apiece.

Description and Uses

Wood of the shipmast locust is dark yellow in color, very durable, and so



Courtesy of the author

Roadsides in the vicinity of Oyster Bay, Long Island, are striking because of the straight trunks of the shipmast locust trees

hard and tough in texture that it is difficult to work. Supplies for general lumber purposes have always been scarce. Numerous hurricane-felled trees found their time-old and specialized usage, even during the last war, as pins for building and as wooden nails and wheel spokes for ships of the American and British navies. A considerable current usage is as insulator posts for power lines and as power line supports attached to the damp walls of the New York subways. At the Morris Arboretum this wood has been used almost exclusively for the making of wooden tree labels, tablets, and benches, and for various types of outdoor construction where the factor of durability in contact with air or soil moisture is of first consideration.

Shipmast locust is a quite distinctive form of the black locust. As a tree it is narrow in form and has a relatively straight single trunk which is fairly re-

sistant to the troublesome locust borer. Its bark is dark in color and sharply, deeply fissured. Its branch spines are shorter and are generally bent upwards. Its leaflets are broad and short. Although it flowers freely it very seldom sets seed; for this reason it has always been vegetatively propagated by root suckers or by root cuttings. It has been learned from W. W. Steiner of the United States Soil Conservation Service that shipmast locust has not proved very adaptable in soils that differ too markedly from the sandy gravels of Long Island. To overcome this drawback of shipmast locust for general planting, at least three other forms of similar habit and with similar wood qualities are now under test by the Soil Conservation Service. There is great need of carefully selected tree forms to meet the constantly specializing demands of modern civilization, and there is a great future for such forms.

Cuttings Difficult to Root

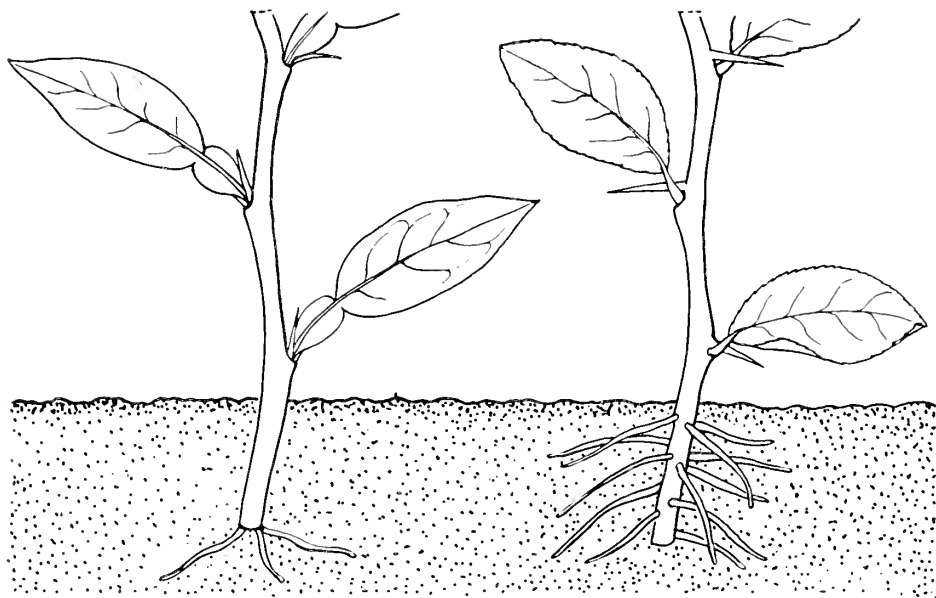
Aided by a new technique with bark grafts

Margaretha G. Mes

IT IS a well known fact that cuttings from some plants root easily when put into a suitable medium, whereas cuttings from other plants root with difficulty or not at all under the same conditions. Cuttings from various plants may differ in the average number of roots produced, or in the time required for roots to appear, or in the position of the roots on the cutting. With reference to position, some plants form roots only

at the cut surface at the extreme base of the cutting; others form roots over the whole area of stem covered by the rooting medium.

There are many factors that influence rooting. In order to discover something about the nature of these factors, experiments were done with two citrus varieties which differ markedly in their rooting capacities. Cuttings of sour orange form only a few roots at the extreme base after a period of weeks, even when treated with hormones. Cuttings of citron form numerous roots over the whole lower part of the cutting after only a few days. (See drawings below.)



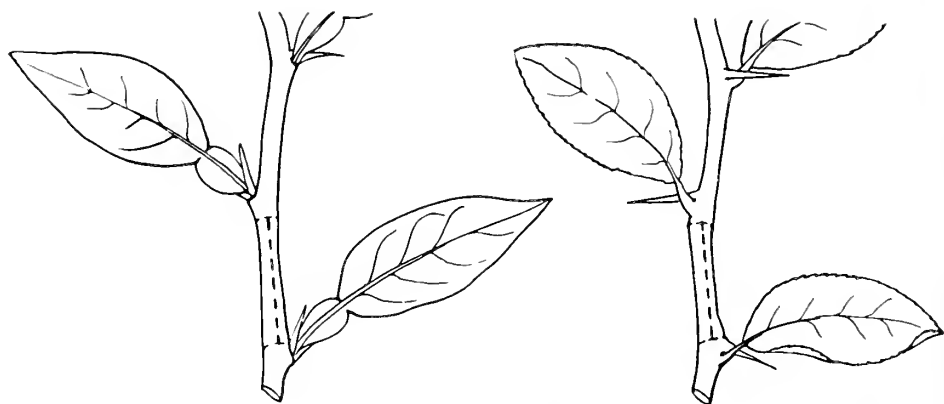
Rooted cutting of sour orange

Rooted cutting of citron

It was desired to find out whether the citron makes some particular substance that stimulates the formation of roots—something that might be transferred to the sour orange cuttings and induce them to root; and whether the sour orange produces some substance that

hinders the formation of roots. To this end, a type of bark graft was made between these two different citrus varieties. These grafts were made in the spring when the bark separated easily from the wood.

Twigs of sour orange and of citron of



Cuts in bark of twigs in preparation for bark grafting. Left, sour orange; right, citron

the same circumference were chosen. The bark was cut around each twig just above one leaf and below the next; then a lengthwise slit was made between these two cuts, as shown in the illustrations above.

A cylinder of bark was removed from the sour orange twig and interchanged with one from the citron twig (see drawings below).

The bark cylinders (*scions*, or *cions*) were securely fastened around the new twigs (*stocks*) with raffia, as illustrated (heavy rubber bands may be used instead of raffia).

The bark cylinder grew together along

its lengthwise cut, and grew to the new twig at the crosswise cuts; *callus* was formed at these places of healing, as shown in the drawings. The bark also grew to the wood of the new twig and became responsible for the increase in thickness of the part of the twig around which it was placed. Since citron stems increase in thickness faster than sour orange stems, the citron bark produced a slight bulge on the sour orange twig, and the sour orange bark caused a slight constriction in the citron twig (see illustrations on opposite page).

After a period of several months, these grafted twigs were used as cuttings. They were cut off at the base of the graft,

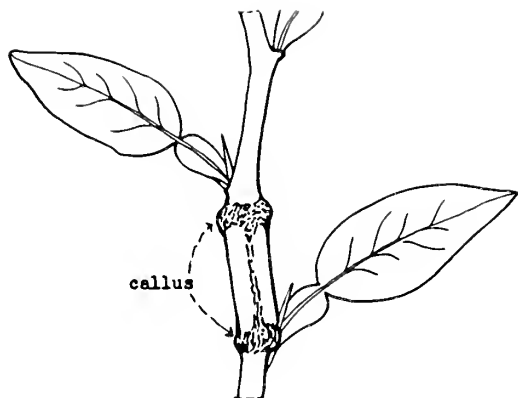


Sour orange twig with cylinder of bark partly separated

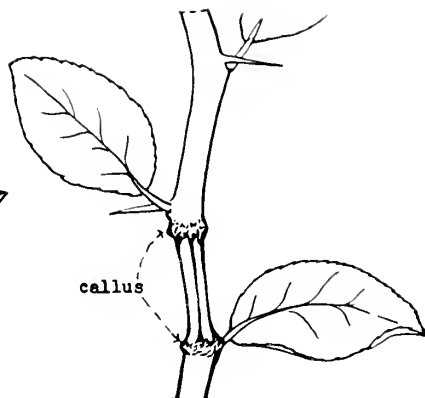
Sour orange twig with cylinder of bark removed

Citron twig with bark cylinder removed (to be put on sour orange twig)

Citron twig with sour orange bark cylinder tied in place



Sour orange twig with citron bark cylinder grafted in place



Citron twig with sour orange bark cylinder grafted in place

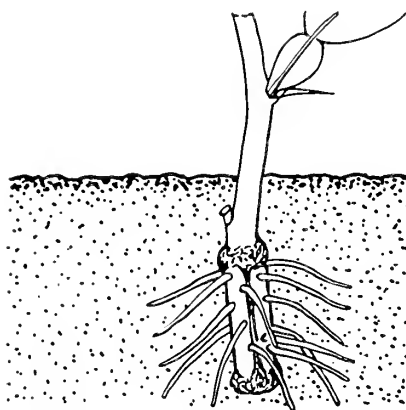
treated with a plant hormone (indole-acetic acid), and put into a rooting medium (peat moss and sand).

The citron bark cylinder on the sour orange cutting formed numerous roots over its whole area within a short period—just as if it had had no connection with the sour orange twig (see drawing below). Its ability to form roots was in no way hindered or altered by growing on the sour orange twig.

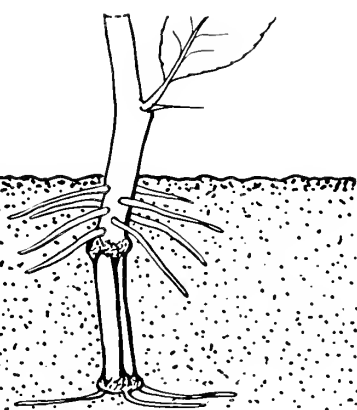
The sour orange bark cylinder on the citron cutting formed only a few roots on the cut surface at the extreme base after a number of weeks—just as it would

have done on a cutting of its own (see drawing). Apparently it did not obtain anything from the citron twig to improve its rooting capacity. Yet on the same cutting, roots were readily and plentifully formed by the normal citron bark just above the sour orange cylinder, as shown in the illustration below.

These results may be of practical importance in connection with cuttings from other kinds of plants that are difficult or impossible to root. It may be possible to start these by first grafting on them a cylinder of bark from a variety that roots more easily.



Rooted citron bark graft on base of sour orange cutting



Sour orange bark graft (on base of citron cutting) rooted only at base and sparingly; citron bark with many roots above graft

Compare drawings on page 95

Propagation of Woody Plants

Fascinating and profitable

C. J. Gilgut

SOME people derive a deep satisfaction from expressing their creativeness in painting, in music, or in literature — the so-called fine arts. Others find an equally deep satisfaction, and often a more lasting pleasure, in horticulture — a practical art. The man who propagates and plants a tree not only has the satisfaction of creating, but all through life has the pleasure of watching that tree grow and develop. How often have we heard a person in his late years say something like this: "That horse-chestnut grew from a seed I planted with my father when I was a little boy, and look at it now — a grand, majestic tree. I remember well the day he helped me dig the hole and bury the nut."

The propagation of trees and shrubs is not difficult — no more so than the propagation of other plants. Propagation may be by seeds — known as *sexual* propagation because the seed is the result of *fertilization* of a so-called *egg* in the female part of the flower by a *sperm* from the male part of the flower. The fertilized egg develops into a miniature plant (the *embryo*), usually surrounded by food material (the *endosperm*) which provides it with nourishment during *germination*, or sprouting; the whole is enclosed by seed coats. Often the seed is surrounded by pulp, which is not part of the seed but a modified part of the flower. Familiar examples are the soft pulp of the peach and plum around the single seed in the center, and the edible part of the apple surrounding the cluster of seeds. Less familiar is the drier pulp of the bright red fruit of flowering dogwood.

Seeds

Propagation by seeds is Nature's way of reproducing plants. The beginner, and often the experienced plantsman, can learn much by observing carefully and then imitating Nature's methods. Note the kind of seed that is produced, when it matures and drops to the ground, how Nature plants it, the kind of soil and conditions of covering and moisture that give good results, how soon the seedlings appear after the seeds drop, and the time of the year when they appear. Although with most plants good results can be had by imitating Nature, with others better results will be obtained if man helps Nature a little. Here are a few suggestions for that purpose.

Collection. Good seeds are available from several reliable seed houses, but it is more satisfying and usually the seeds are fresher if the propagator collects his own — assuming, of course, that he has access to a seed-bearing tree or shrub. The medium or large seeds from a vigorous plant are to be preferred to the runts from a scrawny one — more of the seeds are apt to be viable and produce sturdy seedlings. The seeds should be gathered as soon as the majority are ripe or mature. Delay may allow the birds and squirrels to carry the seeds off, insects to infest and ruin them, or diseases to rot them. In most cases, maturity can be determined by the color and condition of fruit pulp or seed coat. Cutting the seed open and examining the embryo is often helpful.

Cleaning. Seeds that are enclosed in pulp should be cleaned before being stored or planted, to prevent rots from becoming established in the pulp and from there invading the seed itself. Cleaning is accomplished by crushing

the pulp (with care not to injure the embryo within the seed), adding water, and allowing the pulp to ferment in a warm place for two or three days. Fermentation should be permitted only long enough to free the pulp from the seeds; otherwise the seeds may be injured from prolonged immersion in the water. Thorough stirring of the fermented pulp and seeds will separate them. The pulp and poor seeds will rise to the surface of the water and can be poured off, leaving the clean good seeds in the bottom of the container. The seeds should be air-dried, and disinfected by being shaken with a small amount of *Semesan* powder; the excess may be screened off. Seeds of the following should be cleaned before storage or planting: dogwood, magnolia, viburnum, spice-bush, daphne, rose, peach, plum, cherry, crab apple, hawthorn, pawpaw, and mountain-ash.

Seeds embedded in a small amount of pulp may be dried and stored, or planted, without having the pulp removed. Seeds without pulp may be stored or planted without being cleaned, but those in pods should be removed from the pod before being planted.

Storage. A few kinds of seeds, particularly those that mature in the summer, such as the seeds of soft maple, elm, and some white oaks, are ready to germinate as soon as they are mature. These are best planted at once, before they dry too much. Drying hardens the embryo and reduces vitality considerably, so that germination is poor and uneven. If storage is necessary, it should be in a cool place (about 40° F.) in tightly closed containers; or better, the seeds should be distributed in a sand and peat moss mixture that is kept damp but not wet.

The majority of the seeds of woody plants may be stored without reduction in vitality until one is ready to plant them in the fall or in the spring. Indeed, some seeds will not germinate well unless they are stored for a definite length of time before they are planted.

Stratification and after-ripening. For a long time propagators have known that seeds of crab apple, flowering peach and plum, magnolia, viburnum, holly, and certain other plants, do not germinate well if planted fresh. Often, if planted in the fall, they do not come up until spring; and a few kinds do not come up until a year or sometimes even two years after planting. It was thought that such seeds needed to be frozen before they would germinate; for convenience in handling, the seeds were placed in boxes in layers alternating with layers of damp peat moss or a mixture of damp sand and peat moss, and set outdoors or in cold frames over winter. This practice is known as *stratification*.

Recent intensive investigations have shown that in many cases the embryos of seeds needing stratification are immature, and that during stratification further development takes place in preparation for germination. This process



Simple seed-cleaning operation. Clean rose seeds go to bottom of jar, pulp and poor seeds float on water



Planting: seeds of magnolia in rows in flat; those at far end covered with about $\frac{1}{2}$ inch of soil, those at near end still to be covered

of development is called *after-ripening*, and most tree seeds require it. The time for it may be 30, 60, 120, or 180 days, or more, depending on the kind of seed. (Information on requirements of specific plants will be found by consulting references at the end of this article.) Best after-ripening and subsequent germination are obtained when the seeds are mixed all through the damp sand-peat mixture, instead of being placed in alternate layers with it. Optimum stratification temperature is about 40° F.; not only is freezing unnecessary, but in some cases it may even injure the seeds.

Stored or stratified seeds should be protected from rodents.

Hard Seeds. In some kinds of plants the seed has a hard bony coat which hinders the entrance of water to the embryo before germination and is an obstacle to emergence of the embryo from within.

If there are only a few seeds, the seed coat may be cracked or filed—care-

fully, so as not to injure the embryo. For larger lots of seed other methods are more practical. Pouring boiling water over the seeds and soaking for twenty-four hours helps with some; soaking in concentrated sulfuric acid for about an hour helps with others. The length of treatment with acid should be determined with a few seeds first, so that the acid does not reach and injure the embryo. All acid should be washed from the seeds before they are planted. Full-strength acetic acid (which is vinegar) may also be used to soften seed coats. With some kinds, good results are obtained if the seeds are soaked in water for twenty-four hours before they are treated with acid.

Planting. Seeds of trees and shrubs are planted in seed beds in the open if the quantity is large, or in flats or boxes of 3 to 4 inches depth if the quantity is small. Seed beds should be shaded to prevent rapid drying, while the flats or boxes may be kept in a cool cellar or cold frame. Once the seed is planted, the soil should not be allowed to dry and should not be overwatered. When watering is needed, it should be done in the early morning.

A well pulverized, well drained sandy loam should be used. If the soil is heavy, drainage may be improved with sand; if it is sandy, its water-holding capacity may be improved by the addition of heavier loam or leaf mold.

Seeds should be planted in rows—and not too thickly—so that air circulation between plants will be better and there will be less damping-off; weeding will be easier, too.

Depth of planting depends on size of seed. A good rule to follow with smaller seeds is to plant at a depth four times the diameter of the seed. A covering of $\frac{1}{2}$ to 1 inch is sufficient for larger seeds.

Fall-planted seeds should be mulched with any available material except sawdust, and the mulch gradually removed as the seedlings appear.

The planted seeds must be protected from rodents.

Not all plants come true from seed. If the seeds from hybrids (or crosses) such as the named horticultural varieties of crab apple are planted, one will obtain all kinds of seedlings. A few may be as good as the parent plant or better, but many will be undesirable black sheep. Hybrids and horticultural varieties with desirable characteristics, such as upright growth, weeping habit, peculiarly colored foliage, double flowers, or profuse bloom, are reproduced by cuttings, layerage, or grafts, i.e. by *vegetative* means.

Cuttings

Many trees and shrubs are propagated by cuttings made of roots or stems; this method requires equipment such as cold frames or propagating houses if one is to be assured of success, particularly with softwood cuttings. A cutting is a plant part severed from its parent and must be kept alive until it forms roots of its own. Moisture and temperature of the propagating medium, humidity and temperature of the air, and light must be carefully and continually controlled, not only to keep the cutting alive, but also to obtain rooting in as short a time as possible.

Root cuttings may be made of trees such as locust or the tree-of-heaven, or shrubs such as sumae, which sucker freely from the roots. The roots are cut into sections 2 to 3 inches long and planted upright or on a slant in flats or propagating beds. They are covered with about $\frac{1}{2}$ inch of soil and then need no further care except watering to keep them from drying out.

Stem cuttings are of two kinds: softwood cuttings (taken of actively growing stems in summer) and hardwood cuttings (taken of ripe dormant wood in winter).

Softwood cuttings are used for propagating comparatively few trees but a great many shrubs. They consist of 6 or 8 inches of the tips of growing branches and should be taken in the proper condition; this can be determined only by experience. Cuttings that are



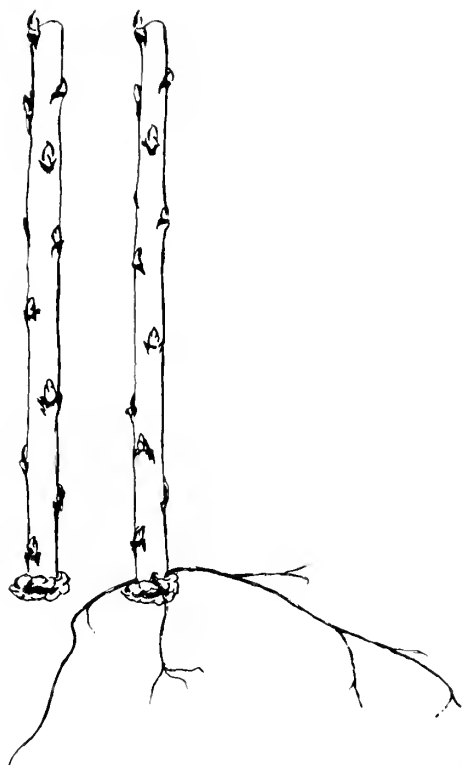
Softwood cuttings before and after rooting

too soft wilt badly when placed in the propagating medium and may not live until they root, while cuttings that are too hard may not root easily.

To facilitate insertion in the propagating medium, leaves are removed from the lower 2 or 3 inches of the cuttings. Dipping the base of the cuttings in rooting hormone powders hastens rooting with most plants, provided the temperature of the propagating medium is maintained at 72° - 75° F.; otherwise (if the medium is cold) hormone powders are of little benefit.

The propagating medium may be a clean coarse sand, but better results are usually obtained with a mixture of equal parts of sand and granulated peat moss. A good mixture is spongy when squeezed in the hand. It contains enough peat moss to hold some water but is loose enough to let excess water drain through easily.

Unless softwood cuttings receive con-



Hardwood cuttings, showing *callus* and roots at base

stant care, the results may be disappointing. The cuttings and the propagating medium must be kept moist but not wet. A partial shade should be maintained over them and the air temperature should be below 80° F. at all times.

Rooting time varies with the kind of plant; under favorable conditions, it may be from six or eight weeks to eight or nine months or more. When the roots are $\frac{1}{2}$ to 1 inch long, the cuttings are planted outdoors if the season is not too far advanced; otherwise they are flatted or potted, and wintered in a protected location. Cuttings taken from the propagating medium and newly planted should be shaded and watered until they become established.

Hardwood cuttings are more commonly used for tree propagation than softwood cuttings. Stems produced the

previous summer are taken in the winter and cut into sections 8 to 10 inches long. Butts of the cuttings are placed together and tied into bundles of convenient handling size. The bundles are buried in moist sand, peat moss, or shingle tow for the winter. The storing medium should be kept constantly moist but not wet and soggy. The first three or four weeks of storage should be at 50°-55° F., at which temperature the cut ends quickly callus (i.e. form a soft wound-healing growth known as *callus*). After that, the temperature is dropped below 40° F. but above 32°, to keep the tops from growing too soon.

Early in the spring the callused cuttings are planted in 4-inch rows in the open ground with the two top buds above the ground. Roots develop and each bud above the ground produces a stem; only one of these stems is allowed to grow on each cutting.

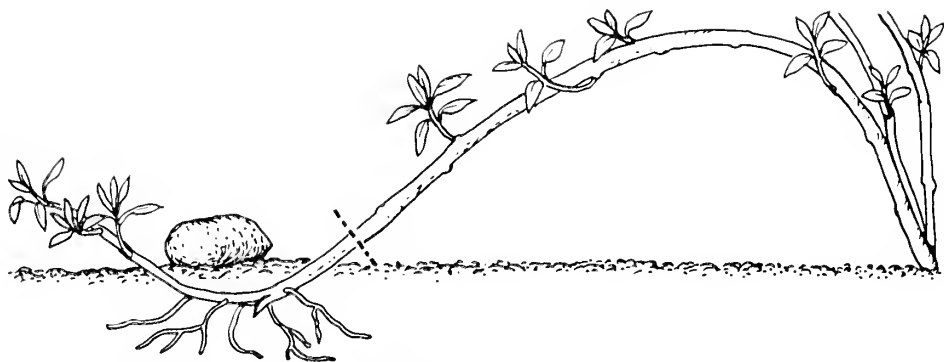
Layerage

Layering is one of the easiest methods of propagating, consequently popular, particularly if only a few plants are wanted. It is best done in early spring or fall. A section of stem about a foot from the tip is buried in the ground. The stem remains attached to the parent plant, from which it receives food and water, until roots develop on the buried portion and the new plant is able to take care of itself. It is then severed from the parent and moved where desired. Rooting is hastened by notching, scraping, or otherwise wounding the underside of the stem before it is covered with soil. Bent wire may be used to peg the stem down, or a stone may be placed over it to anchor it. Layering is especially suitable for the propagation of shrubs.

Grafting—Principles

When a plant does not come true from seed, such as the red flowering dogwood, and cuttings do not root easily, it is reproduced by grafting.

Grafting depends on inserting a cutting (called a *cion*, or *scion*) of the desired



Simple layer: stem notched on underside, covered with soil, and held down with a stone; roots growing near cut. Slanting black line shows where stem can be cut to separate new plant after roots are well developed

plant into a rooted plant which provides the root system, in such a way that the two unite and grow together. Grafting is possible because of a specialized layer of growing tissue (the *cambium*) located between the wood and the inner bark of woody plants. The cambium layer is thin and delicate and is easily injured or killed if allowed to dry out.

In grafting, the cambium layers of the cion and stock are placed against each other and the graft is bound with waxed string, raffia, rubber bands, or grafting tape, to insure close contact and to keep the pieces together. Often the graft tie is sufficient to prevent drying of the cambium; but with some plants it is better to place the graft in a grafting case, greenhouse, or cold frame where the proper humidity can be maintained until the graft knits. In the open, the graft may be protected against drying by grafting wax. After the graft knits, the tie is cut to prevent girdling.

The choice of understock and its condition are important. It should be compatible with the cion so that the graft forms a quick and strong union. Usually a seedling of the same variety as the cion, or a closely related variety, is used for this purpose. For example, the red flowering dogwood is grafted on a seedling of the white flowering dogwood, and flowering crab apples on apple seedlings.

The main points in grafting, then, are these:

- (1) a compatible stock and cion,
- (2) a close contact between the cambium of the stock and the cion, and
- (3) the prevention of drying of the cambium while the graft knits together.

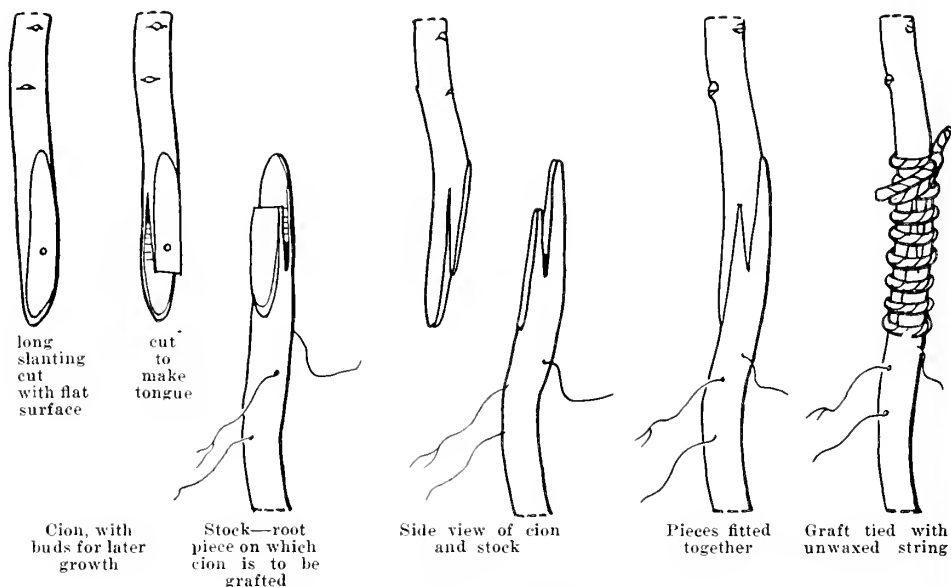
There are numerous ways and variations of making a graft. Only a few of the commoner ones will be mentioned here briefly. A well sharpened knife with a thin blade is a prerequisite for making good cuts.

Splice, Whip, or Tongue Graft

The whip or tongue graft is used primarily to make root grafts; the grafting is usually done in the winter. Pieces of root with a diameter of a pencil (or slightly larger) are selected and cut into pieces 2 to 4 inches long. Cions with a diameter as near that of the root as possible are stored with the root pieces in damp sand or peat moss until one is ready to make the graft.

With plants that are difficult to root, root grafts are a little more reliable than cuttings because the root piece nurses the cutting until it makes its own root, or, if the cutting fails to root, then the root piece becomes the root system itself.

The cion is made with a long slanting cut (with a flat surface) at the base. The



Steps in making a whip graft

slanting base of the cion is then split for a distance of 1 to 1½ inches so as to make a tongue. This split is started on the long slanting surface about a third of the distance between the pith and the basal tip of the cutting. It is directed slightly across the grain and toward the pith, so as to produce a cut nearly parallel with the face of the long slanting cut; thus the tongue is formed. In making this cut, the propagator should be careful that the knife does not slip—a cut-off finger does not often grow out again.

The root piece is prepared in the same way as the cion, and the two are placed together so that the tongue of one fits into the cut of the other. The cambium layers along one side are carefully matched and the graft is tied with string. If properly made, the pieces will match well and there will be no protruding lips of root or cion.

The grafts are then tied in bundles and stored in moist sand or peat moss at a low temperature, where they grow together before being planted out in the spring. Unwaxed string is preferred by most propagators because it rots off in storage by the time the graft grows to-

gether; thus it is unnecessary to cut the string later to prevent girdling.

The whip, splice, or tongue graft is used to graft pencil-thick stems in the upper parts of the tree, as well as for root grafting.

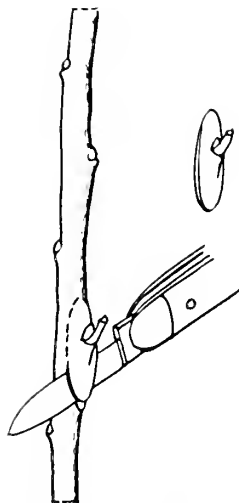
Bud Graft

Budding is done on seedling plants growing outdoors in July and August, or it may be done inside on potted plants. It is used for propagating double-flowered peach, ornamental cherry and plum, flowering crab apple, red-leaved Japanese maple, and other plants.

Choose stock about ½ inch or more in diameter, because it is easier to work with than smaller stock. The leaves and twigs are removed from the lower part of the stem, and two cuts are made through the bark to the wood about 2 inches from the ground. The first cut is lengthwise of the stem and about 1 inch long; the second cut is across the top of the first one and long enough so that the resulting corners of the bark can be lifted and the bud slipped between it and the wood. Buds are obtained from well developed stems of current growth of the



T-shaped cut through bark of stock, from which leaves and branches have been removed



Single bud being cut from bud stick, from which leaves have been removed



Bud being slipped into cut in stock



Bud tied in place

Steps in bud grafting

desired variety. The leaves are first trimmed off. The entire stem is carried, and the better buds from the midsection are cut from it as needed. For the removal of the bud, the cut is started $\frac{1}{2}$ inch below the bud, is made deep enough under the bud to include a sliver of wood, and comes out to the surface about $\frac{1}{4}$ inch above the bud. The bark of the stock is lifted and the bud slipped in; the bud, with bark of the stock pressed around it, is tied with string, raffia, rubber tape, or cloth budding tape. In three weeks the bud should be grown to the stock; then the tie should be cut by having a knife run across it on the side of the stock away from the bud. If at that time the bud is shriveled and brown, the stock can be rebudded. The following spring, as soon as the stock shows signs of growth, it is cut off just above the bud so that the latter may receive all the growing strength from the root.

Saddle Graft

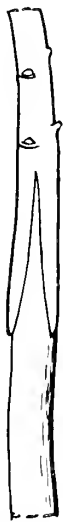
This is a useful graft where small cions are wanted on a small stock. It is often used for propagating red-flowered dogwood on seedling roots of the white-



Stock with wedge cut



Cion split to fit over wedge



Pieces fitted together

Saddle graft

flowered dogwood.

The stem of the stock is cut off 2 to 3 inches above the ground and cut to form an upright wedge with straight flat sides about 1 inch long. The base of the cion is split, the cion is seated on the

wedge, and the cambiums are matched up. Tying and waxing complete the job.

Of all the ways in which woody plants can be propagated, grafting is the most fascinating. When sufficient skill and experience have been acquired so that the majority of grafts live and grow, then one is well on the way to being a plantsman.

Propagating one's own trees and shrubs—whether by seed, cutting, layerage, or graft—is not only a means of obtaining plants one wishes to have; it provides the added satisfaction of watching one's own propagated plants grow, and fosters a keener appreciation of the trees and shrubs one already has.

References for further information on propagation of trees and shrubs:

"Improved Practices in Propagation by Seed"—L. C. Chadwick. Distributed by Herbst Brothers, 92 Warren St., New York (25¢).

"Propagation of Plants"—Kains and McQuesten. Published by Orange Judd Publishing Co., New York.

"The Book of Trees"—A. C. Hottes.

"The Book of Shrubs"—A. C. Hottes. Published by A. T. DeLaMare Co., 447 West 37th St., New York.

[An article on the propagation of perennials appeared in PLANTS & GARDENS, Summer, 1947.—Ed.]

PRUNING

When the urge to prune comes in the spring or summer, keep in mind one very important rule: Never prune unless there is a very good reason. Most plants are beautiful if let alone; certainly this is true of trees. However, there are places where dead or diseased branches should be cut out, where vistas should be opened through dense foliage, where cross branches interfere with normal growth, where transplantation has just occurred and evaporation must be lessened by reducing the leaf surface, or where pruning must be done for utility reasons. These are the reasons for pruning.

Certain trees like the sugar maple, birch, and yellow-wood bleed profusely when cut in the spring; hence their pruning had best be deferred until early summer. Other things being equal, however, the earlier in the spring the pruning is done, the better.

So, when one reaches for those pruning shears, he should consider carefully the reason for pruning. Is it necessary? If it is, it should be done early and well, but the bleeders should be skipped until the early summer.

DONALD WYMAN.



Sugar maple (*Acer saccharum*), a bleeder, should be pruned in the summer if at all



The Dove-tree

An unusual flowering tree

Donald Wyman

Ernest Henry Wilson, who brought back many excellent plants from China, made a special expedition to find this interesting tree (*Davidia involuerata*) which had been reported by travelers in China. After a journey beset with delays and dangers, he finally found the trees in central China and sent thousands of seeds back to the great Veitch Nurseries in England, which firm had commissioned him for this particular trip. Although the seeds were planted in the spring of 1901, not a single one had germinated by April, 1902.

One can imagine the disappointment of Wilson as he examined all those seeds on his return from the Orient. Every method known to resourceful propagators had been used in sowing the seed but it looked as if failure was certain. How-

ever, within a few months, nearly 100 per cent of those which had been sown out of doors germinated, while practically none of those sown indoors did. Even today, the few seeds available from dove-trees in this country are in many instances disappointing in their germination.

The dove-tree is valued for the pairs of beautiful white leaves that go with the clusters of very inconspicuous flowers; these *floral bracts* are often as much as 6 inches long and 3 inches wide. The tree grows to 50 feet or more in height. There are trees from Newport southward in full bloom during mid-May, but the tree fails miserably in the colder climate of Boston. Small plants are available from a few nurseries in this country who have sources of seed. Many who have had the privilege of seeing the plant when it is in full flower agree with Wilson that it is one of the most beautiful of the flowering trees of the northern temperate regions.



Shaggy-mane (*Coprinus comatus*)—about 1/3 to 1/6 natural size

Mushrooms May Be Weeds in the Garden

But here are three that are good to eat

Alexander H. Smith*

THE human being is a creature of habit in regard to his thinking as well as his physical activity. Once an idea becomes fixed in a person's mind, it is often more difficult to eradicate it than to implant a new one. Mushrooms are seldom thought of as weeds in a garden, and yet they can be—and are likely to appear in the best regulated gardens. They may even cause the gardener some inconvenience; but because they are so short-lived, they are easily missed. Most people never think of these garden types as mushrooms, because their acquaintance with mushrooms is limited either to the kind they buy at the grocery store, or

(if they are more adventurous) to the "pink bottoms" they collect in old pastures. Anything else of that general sort is likely to be regarded as a toadstool.

Kinds

Actually, several of the inky-caps commonly appear in gardens, and are very good to eat. The three kinds of inky-caps that appear most abundantly (the three species of the genus *Coprinus*, in scientific parlance) are the shaggy-mane (*Coprinus comatus*), the mica-cap (*Coprinus micaceus*), and the one most frequently called inky-cap (*Coprinus atramentarius*).

The **shaggy-mane** is perhaps the most attractive member of the trio and is the one likely to appear under the shrubbery and in the hedges; but it is by no means limited to these places. It may appear in quantity in the lawn or in places in the garden where the soil is packed—such as along paths. It is one of the best of edible fungi, and one of the easiest to recognize.

The **mica-cap** grows on wood but comes up at times in places where no one

*Author of *Mushrooms in their Natural Habitats*, published by Sawyer's, Portland, Oregon, 1949. 636 pages. A very useful book for the woodland naturalist as well as the person with a scientific bent. Magnificent stereo-photographs go with it—231 kinds of mushrooms in full color.—ED.



Courtesy of the author

Mica-cap (*Coprinus micaceus*)—about $\frac{1}{2}$ natural size



Elsie M. Kittredge

Typical *gills* on underside of a mushroom cap

suspects wood in the substratum. In such occurrences there are almost certain to be some old tree roots rather deeply buried in the vicinity. The mica-cap produces "fruits," or caps, both in the spring and in the fall and comes up in dense clusters—so that it is rather easy to collect enough for a meal. The small yellowish to pale tan caps are very soft, and so it is best to collect them shortly before one plans to cook them.

The last of the trio, the **inky-cap** (*Coprinus atramentarius*), is less desirable as food than the other two (according to some I know who have tried all of them) but is fairly fleshy and grows in large bunches like the mica-cap. The surface of the cap is gray to grayish brown and varies from smooth to slightly scaly. It is the one likely to appear in well prepared beds and completely ruin them by pushing up the soil over large areas. In addition, the old caps are very unsightly.

As the cap expands (on all inky-caps), the *gills* on the underside gradually turn black and break down into an inklike fluid. This process is the distinguishing feature of the genus *Coprinus*. Actually it is a process of self-digestion. When the spores (reproductive cells) have been matured and discharged into the air, an enzyme is formed; this enzyme causes the cells that produced the spores, and all of

the gill tissue, to liquefy. The person who is collecting inky-caps for eating should not store them overnight in a refrigerator if the gills are black, because he is likely to have nothing left by the next morning but a copious quantity of the dark inky fluid. The caps that are best for the table are those in which the gills have not begun to darken.

Caution

There are a few people who cannot eat inky-caps without experiencing some discomfort, and a few cases of poisoning are on record in the literature, but it has been amply demonstrated that not more than one person in a hundred is so affected. The safe way to proceed is to eat only a small quantity the first time (several small caps of one like the mica-cap or one large cap like the shaggy-mane). If any difficulty should develop, it is not likely to be severe. One can find statements in the literature to the effect that if alcoholic beverages are consumed along with the inky-caps poisoning is likely to result. Any cases of mushroom intoxication from eating inky-caps are of interest medically, and even the mild ones should be reported to a physician. For most of us, however, the "inkies" are excellent food, easily obtained in the spring and fall—altogether useful weeds in the garden.

Garden Chrysanthemums

Will bloom in unusual spots if transplanted in bud

E. J. Kraus

DURING the last score of years the use of chrysanthemums as garden subjects has increased very greatly, thus helping to accent the striking coloration of autumn foliage and often prolonging the parade of color well beyond the period when foliage has fallen and a season of drabness may be expected.

Full use of these gorgeous autumnal flowers is not being made, however. With very little added care they may be fully used in areas and spots which are usually left without them. I refer particularly to shaded spots in the garden, on the shaded sides of buildings, or beneath trees or shrubby masses; window or terrace boxes; and parts of the garden where summer annuals are grown until autumn frosts destroy them.

The desired effects may be had by transplanting well developed plants full of buds or even beginning to come into bloom. Thus selections as to color, uniformity of shape, and general design may be effected readily at very modest expense. The essentials in gaining these ends are (1) well grown and shapely plants and (2) average care in digging such plants and transplanting them to sites where it is desired that they bloom.

Raising Well Grown Plants

The first of these essentials is gained in much the same manner in which plants are usually handled in the open garden or sunny borders. In general, thrifty rooted cuttings, or well rooted divisions of an overwintered clump are best.* These are planted in the usual manner in a location that will receive

plenty of sunshine during the growing season and such fertilization and watering as may be required to grow sturdy plants. The plants will require some care as to pruning, but this need not be either a tedious or a time-consuming task. The plants are most conveniently grown in a plot by themselves; or just before coming into bloom they may be taken from the regular border plantings, which are often improved by thinning. The young plants should be set out in the usual way, 18 inches or 2 feet apart; this avoids crowding, and simplifies removal in the fall without undue disturbance to neighboring plants—some chrysanthemum varieties tend to develop into very large plants.

Each cutting should be permitted to grow vigorously as a single stem until it is 12 to 14 inches tall. Then it should be **cut** back (with any convenient tool) so that 6 to 8 inches remain. Merely pinching out the tip is not enough; the plant must have a real heading back or pruning. Within a week or ten days buds will begin to grow out as sturdy lateral branches—buds in the axils of about five of the upper leaves. If the original single stem has been allowed to become spindling and woody because of improper care, both the number and the quality of new shoots will be less, and an inferior plant will be the final result. If the plant has been growing well, the side shoots will develop vigorously and rapidly. When these new shoots in turn have grown 12 to 14 inches, they too should be pruned back to a length of 6 or 8 inches. Each of these branches will put out four or more shoots, the number depending upon the variety and the

*An article on spring propagation of chrysanthemums appeared in *PLANTS & GARDENS*, Spring, 1949.—Ed.

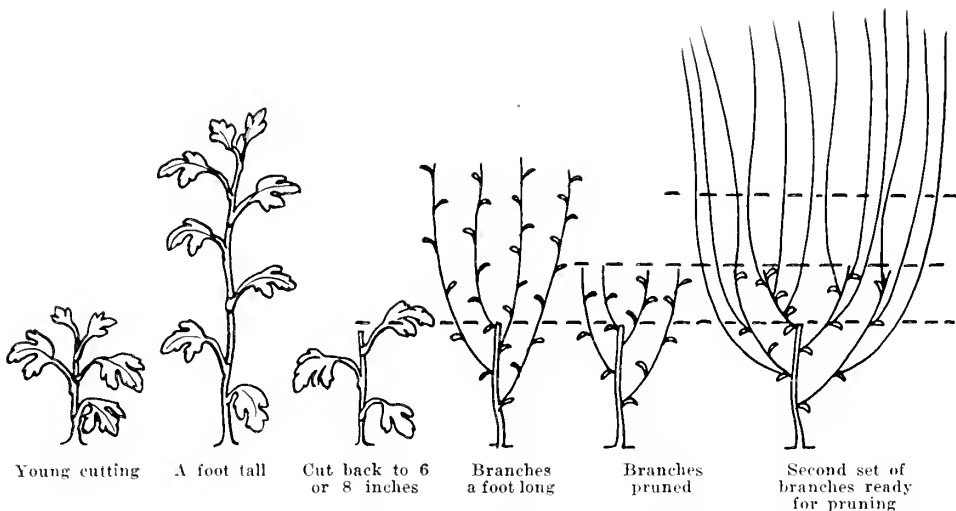


Diagram of successive stages of growth and steps in pruning to produce a compact chrysanthemum plant with many branches

vigor with which it is growing. Thus at the end of a few weeks, instead of a single tall stem sparsely branched, a compact plant consisting of twenty or more branches will be developed. If the second set of branches grow so vigorous-

ly that they exceed a length of 14 to 18 inches by the end of July or early August, they may be headed back like the others; but often by that time flowering shoots will be making their appearance.

In their early stages of development

Chrysanthemum stems: left, with young leaf shoots (branches); right, with young flower shoots



the flowering shoots may be distinguished from leaf shoots by the fact that they come out from the stem at nearly right angles and their young leaves are curled inward, resembling small crab claws. The potential leaf buds are at an acute angle with the branch and their leaves are folded over one another and straight—not curled inward toward their tips.

In my own experience I have found that this pruning does not tend to delay flowering. Time of flowering is far more dependent upon temperature conditions (cold days and nights hasten it) and reduction in the number of hours of daylight as autumn approaches.

Transplanting

Thus near the end of the summer growing season one should have developed compact, low, shapely plants having dozens of flowering branches and buds. Now comes the second operation, transplanting. Two or three days before the plants are to be dug, the soil should be thoroughly watered, especially if it is sandy and does not ball easily. In no case, however, should digging be done while the soil is soggy or muddy. First a stout twine should be tied around the mass of branches to facilitate handling and avoid breakage. Then with a sharp spade one should dig at least 9 inches to a foot deep all the way around the plant to be moved. As much soil as possible should be retained on the roots. It is not at all essential to move an excessively large mass of soil; a ball 9 to 12 inches through is sufficient, depending upon the size of the plant. As soon as

possible, the plant should be put into its new location, whether pot, window box, or open ground. The hole should be large enough to accommodate the entire ball of soil. Then loose soil should be added and thoroughly watered in so that no space remains around the mass of roots. After the water has settled, some dry soil should be pulled up around the base of the plant. One should then leave the plant alone—by no means pull at it or try to lift it after several days to see if the roots are growing. If the job is well done there is usually little or no wilting of foliage or buds; the plant recovers fully after a few days, and a long and satisfactory blooming season may be expected.

Pots or boxes of newly transplanted chrysanthemums may be set in a shady spot for several days; permanently placed ones may be given a little shading. I have found this necessary only when the boxes were exposed to glaring sun during unusually bright warm days which may occur during the autumn. Small butter tubs, wooden pots of various styles, or low earthen pots are more pleasing than the taller styles.

The whole procedure is very simple and the results far outweigh the effort expended. Some of the naturally low-growing chrysanthemums like AMELIA and EARLY HARVEST need no heading back during their growing season; but it has been my experience that the later-flowering varieties and even many of the Early English, give a longer period of bloom and a more colorful display than the earlier-summer-flowering kinds.

A garden such as this may easily be made by the method described in this article. This particular garden was constructed by the Brooklyn Botanic Garden in cooperation with *House Beautiful Magazine*.









A garden path bordered with summer-blooming perennials

This garden path of flagstone, banked with perennials and leading to an outdoor patio, is a never-ending source of joy to those who live with it. From snowdrops in February to chrysanthemums in November, there can be continuous bloom.

This summer picture shows an edging of tussock bellflower (*Campanula carpatica*) and edging candytuft (*Iberis sempervirens*), behind which tall delphiniums, astilbes, Shasta daisies, and phlox make an attractive background. Zinnias, marigolds, and snapdragons are colorful annuals for the spaces left bare by tulips and other spring-flowering bulbs.

Such a border can easily be worked out along a path, provided arrangements are made now. A plan should be made on paper before the plants are ordered; and with the same design carried out in the autumn planting, the path can look like this next summer.

A strip of well-kept lawn enhances the beauty of any flower border.

ALICE RECKNAGEL IREYS.



Redwood Trees

How to grow them outside of California

Hester M. Rusk

MOST of us have long believed that redwood trees grew only in California. It is true that the two kinds dealt with in this article now grow *wild* only in a small part of California—and (one of them) in part of Oregon.* But they have been *cultivated* in various parts of the world for at least a hundred years. We have been told of about five hundred of them growing in foreign countries from Guatemala City to Tasmania, and about sixty in the eastern and southern United States. Many of these have been raised with almost no knowledge of proper care.

Many more of these beautiful trees can be grown if more people can get young trees to plant and can learn where to plant them and how to take care of them. Various organizations and individuals are encouraging and promoting the raising of redwoods from seeds. One of these is G. E. Schilling of Redwood City, Cali-

*A third kind, the dawn redwood (*Metasequoia glyptostroboides*), was recently discovered wild in a small area in China. An account of this discovery appeared in PLANTS & GARDENS, Winter, 1948, page 231. Since 1947 institutions and individuals have been experimenting with seedlings of the dawn redwood, in an attempt to discover, among other things, how far north they would grow. So far they have been reported to survive the winter in southeastern Alaska and central Vermont.



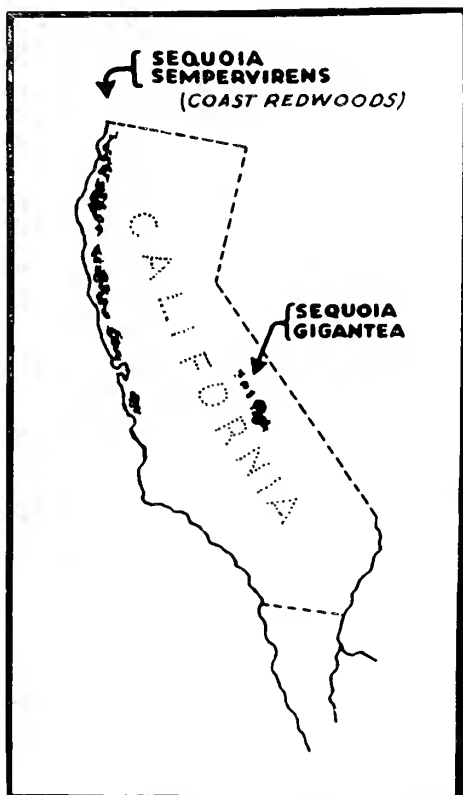
Native coast redwoods (*Sequoia sempervirens*) in California

Courtesy of Save-the-Redwoods League

ifornia; another is W. Warren Anderson of Kentfield, California, who kindly supplied most of the information in this article. Information may be found also in the book "Big-trees" by Walter Fry and John R. White. More young trees are becoming available every year, for experiment stations, parks, and amateurs in suitable localities.

Kinds of California Redwoods

There are two kinds of redwoods (or sequoias) in California. The true **redwood**, or **coast redwood** (*Sequoia sempervirens*)



Courtesy of Save-the-Redwoods League

is the tallest of all trees. It grows in an irregular strip up to 35 miles wide and about 500 miles long, from Monterey County, California, north to Salmon Creek Canyon in southwest Oregon. (Map on previous page.) Most of these trees are preserved in public wilderness parks. In these parks are about 60,000 acres of ancient trees 300 feet tall or more.

The coast redwood usually grows on the lower slopes or in valley bottoms where alluvial soil is deep and fresh running spring water is not far below the surface all the year. It does not do well in stagnant swamp water. There is little or no snow in most of the coast redwood country, but 30 to 60 inches of rain falls there in the winter, and heavy fogs provide moisture in the dry summer months. Temperatures most of the year range from 45° to 65°F., with extremes from 15° to 100°F.

The **giant sequoia**—**Sierra redwood**, or **big-tree**—(*Sequoia gigantea*, or *Sequoiadendron giganteum*), while not the tallest, is the oldest and most massive living thing on earth. Many fallen trees have been found whose annual rings indicated ages of 2000 or even 3000 years. Trees 40 years old may become 60 feet high and a foot in diameter. The bark is lighter brown than that of the coast redwood.

The giant sequoia is native, in scattered groups, to the western (rainy) slopes of the inland Sierra of California, from the Lake Tahoe region south for 260 miles to the Sequoia National Forest. (Map on previous page.) These trees are far less numerous than coast redwoods and are scattered in seventy separate groves; in individual groves the giant sequoias number from as few as six to as many as several hundred trees.

The giant sequoia grows naturally at elevations of 4000 to 8700 feet, lower in the North and higher in the South. Temperatures there range from 25° below zero to 100°F.; annual precipitation is from 45 to 60 inches, much of it as winter snow. This tree thrives in grassy basins with deep sandy to gravelly soil

and in ravines where there is abundant fresh water runoff both above and below ground. Its tree neighbors vary from yellow pines at lower elevations to firs at 8000 feet.

The giant sequoia can endure fog or do without it, and it does not require altitude. There are over a hundred sturdy specimens growing in Marin County, California, alone—at altitudes from 30 to 100 feet above sea level, in coast redwood climate. In the city of Fresno, in one of the hot dry regions of California, there were until recently two giant sequoias of considerable size. One was killed by being moved to make way for a building; the other was drowned by a burst water main. Many families in Fresno have smaller specimens in their yards now.

Insects and diseases have made no progress against redwood trees.

Where They Can Be Grown

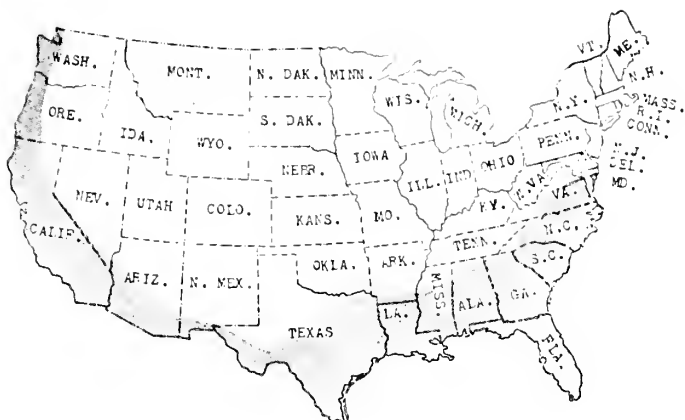
Anyone who wishes to grow sequoias should choose the right kind for his climate, for there is a wide difference in winter hardness between the two species.

The **coast redwood** is less hardy than the giant sequoia and more difficult to grow anywhere but in its natural habitat. It probably has a chance only in about fourteen of our coastal damp-air states, no farther north than the head of Chesapeake Bay. Several are growing in eastern and southeastern coastal states.

We have been told of six coast redwoods in South Carolina, four of them about a hundred years old. One in Norfolk, Virginia, is 75 feet tall and 35 inches in diameter at 4½ feet above the ground. It was planted in 1860. (Photo on page 116.)

The **giant sequoia**, not so tender as the coast redwood, offers a wider range of choice in growing conditions. It will grow in about forty to forty-two of our states. Six specimens are thriving in Roanoke, Virginia, and a whole avenue of them was recently planted on the Dupont place in southeastern Pennsylvania.

Shaded area shows where the climate is nearest that required by the coast redwood (*Sequoia sempervirens*). Local conditions in some places within this area may not be suited to this tree



There is one at Bristol, Rhode Island, near the shore of Narragansett Bay, belonging to Mrs. George A. Lyon. It survived the hurricanes of 1938 and 1944 which destroyed 358 trees on her property. It is 64 feet tall and 8 feet in circumference at 4 feet above ground. This tree is growing farther north than any other giant sequoia we have heard of and is probably the only large one in New England. It was planted in 1903 when it was 12 feet tall. (Photo on page 117.)

One was planted near Atlantic Highlands, New Jersey, about the same time and has done well, with the advantage of the seacoast moisture.

Another, planted at the Morris Arboretum of the University of Pennsyl-

vania in Philadelphia in 1933, is now about 16 feet tall.

One at the Clayton Pinetum, Roslyn, Long Island, is about 40 feet tall and 5 feet 3 inches in circumference at 4 feet above the ground. In its protected position on the North Shore of Long Island, it is doing well. (Photo on page 118.)

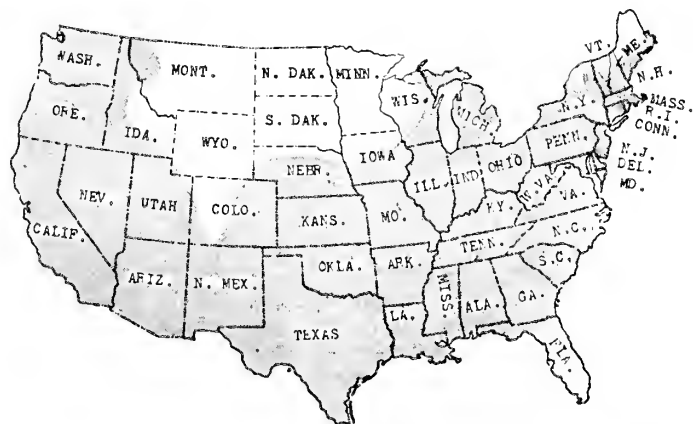
The oldest one we have heard of in the East was planted about 1856 to 1860 at the Tyler Arboretum near Philadelphia. (Photo on page 119.)

How to Grow Them

In adjusting sequoias to a new climate, two important facts must be kept in mind.

1. Sequoias are wild; any wild plant must have its needs very carefully

Shaded area shows where the climate is nearest that required by the giant sequoia (*S. gigantea*). Local conditions in some places within this area may not be suited to this tree



Maps courtesy of W. Warren Anderson



Coast redwood (*Sequoia sempervirens*) on Magnolia Street in Norfolk, Virginia (page 114)

studied, for it is likely to be less well understood than a plant that has been under cultivation for a long time.

2. Sequoias are evergreens; evergreens are never completely dormant, even in the winter.

Specific Instructions

Beginning. Sequoias should be transplanted young. They should always be shipped in the pots in which they have grown, so that their roots are not disturbed. They must not be dug from the wild or from the nursery row, or shipped bare-rooted.

Sun and wind. If the midsummer sun is very hot, the young sequoia should be at least partly shaded during the middle of the day; morning and late afternoon sun are better for it. Summer or winter, it should be protected from strong winds. Plenty of water at the roots (with good drainage to allow

them enough air) will help the young tree to stand the amount of sun and wind to which it will be exposed when it is finally planted in the earth.

Water. The pots must have drainage at the bottom. The soil should be always moist, but not wet, just below the surface. Setting the pots into the ground in the summer reduces the work of watering. As cold weather approaches growth should be retarded by less plentiful watering; tender new growth is more sensitive to frost or wind.

Cold. If the trees are kept in pots till they are 3 to 4 years old, the adjustment to cold weather can be made very gradually. The pots can be moved indoors on cold nights and bitter days; and the trees should be given a little more exposure each winter. The soil in the pot must never be allowed to freeze.

Fertilizing. Too rapid growth is always tender. Better than too much fertilizer is good potting soil with nothing added. Fertilizer should be given in sparing amounts, not more than three times a year, and not later than August; growth should be slower toward autumn.

Repotting should be done when the tree is too big for its pot; no exact schedule can be given. Early spring is the best time. Pots or tubs are better than cans; they are larger at the top, and so it is easier to remove the soil and roots in one mass. Roots projecting from the drainage hole should be cut off with a sharp knife. Clay pots may be painted on the outside to retard evaporation; or glazed pots may be used if they have drainage holes. The tree should be changed from a 3- or 4-inch pot to an 8-inch one, then to a 5-gallon tub. If the tree is received in a waterproof paper container, it may be put into a larger pot at once, with no disturbance of the roots. The paper container will have disintegrated by the time the roots need more space.

Potting soil. Sequoias need a loose, mildly acid soil. A good mixture is: one half good garden loam; one quarter sharp river sand, not too fine; one quar-

ter redwood humus or topsoil from any conifer forest—or half as much shredded peat moss. If the loam is already sandy, less sand should be used. If it is heavy with clay, more humus should be included. For a week or two after being repotted, the trees should have more water and more protection from sun and wind.

Shearing can help the tree to grow symmetrically, but sequoias cannot survive pruning. Branches that grow out too far should have their tips gently snipped off with sharp scissors; thus their growth can be retarded while other branches catch up. The leader should never be cut. As the lower branches die, they may be cut off close to the trunk.

Planting out. A suitable location is almost as important as a suitable climate. Sequoias must not be planted on top of a dry hill. The soil must be deep and mildly acid. Shallow soil over bedrock or hardpan, or highly alkaline soil is undesirable. The root system of sequoias is tremendous. A young tree 4 inches tall was found to have a number of fibrous roots each 30 to 36 inches long. A tree 100 feet tall spreads its roots in a circle 200 feet in diameter and 100 feet deep in favorable soil. Some of the roots spread close to the surface and thus get air; others bore deep where there is always plenty of water, and serve to anchor the trunk. Until their roots grow deep enough, the trees must be given water in summer drought.

Planting. The hole should be dug at least 3 feet wide and deep, then partly filled with a good soil mixture until it is just deep enough to admit the tree roots with their ball of earth. A recommended soil mixture to fill in around the tree consists of rich garden loam (sandy or with sand added) mixed with redwood humus—one fourth to one half; or it may be humus and topsoil from any conifer forest; but if the latter is used, about $\frac{1}{4}$ bushel of redwood humus is a good thing to add, to inoculate the soil



George C. Henderson

Giant sequoia (*S. gigantea*) at the home of Mrs. George A. Lyon, Bristol, Rhode Island (page 115)

with the right kind of cooperating lower organisms. The soil around the newly transplanted tree should be watered plentifully.

Humus over the ball of earth, and a mulch of leaves or straw will help to conserve moisture and admit air to the roots. No fertilizer is needed at the time of planting out. Each subsequent spring, well rotted cow manure may be scattered on the mulch and watered in.

The area around the sequoia should not be covered with sod or with the hard-packed soil of a path or driveway. It should be kept mulched—permanently—with pine needles or oak leaves, or cultivated very shallowly. It may be planted with wild flowers that naturally grow in leaf mold in the shade, or with a few shallow-rooted shrubs such as azaleas and rhododendrons.

Winter protection. Sequoias should



Branches and cones of
coast redwood (*Se-
quoia sempervirens*)
 $\frac{1}{2}$ natural size

Courtesy of the late W. L. Jepson



be planted where cold air drains away from them—not in the lowest hollows where the coldest air collects. The minimum temperature for coast redwoods is considered to be 15°F. for mature trees, 25°F. for very young ones; for giant sequoias, minus 25° to 30°F. for mature trees, 15°F. for very young ones. But these figures are only approximate, because many factors other than temperature affect the hardiness of plants—especially of evergreens.

More evergreens are killed by winter drought than by cold. Evergreen foliage loses water rapidly in winter winds (the evaporation lowers the temperature, too). If the soil is completely frozen so that the roots cannot absorb water, the tree will die from dryness. Three things that will help a sequoia to stand the winter are: 1) breaking the wind; 2) reducing freezing of the soil; 3) increasing the water in the soil.

A young tree can be sheltered from the wind by a cylinder of woven wire fencing covered with burlap or sacking sewed in place. The cylinder should be as high as the tree. If it is as much

Giant sequoia at the Clayton Pinetum, Roslyn, Long Island (page 115)



Courtesy of the late W. L. Jepson
Branches and cones of giant sequoia (*Sequoia gigantea*)—1/3 natural size

as 6 feet high it may have to be braced with guy-wires and stakes. Inside the cylinder a mulch of leaves or hay may be lightly packed in, about a foot deep, to retard the freezing of the soil. On warm sunny days water may be given through a hose slipped under the cylinder and mulch. Wetting the mulch (by watering from above) would lessen its insulation value. This kind of protection and care should be continued for five years after the trees are planted out. As soon as the roots are well developed below the depth to which the soil is likely to freeze, the trees are better prepared to stand the winter.

Wind protection. Sequoias grow naturally in groves (either pure sequoia stands or mixed with other evergreens), where they are protected from wind, summer and winter. The wood of the giant sequoia is more brittle than that of the coast redwood—almost as brittle as willow. Solitary trees are usually broken and battered; but those in dense

groves seldom show wind damage. The coast redwood suffers more from the drying effects of wind than the giant sequoia, because its leaves are larger and more exposed and so lose water faster. Other conifers should be planted so as to shelter sequoias from the prevailing winds.

If these instructions are followed with reasonable care, almost anyone (in any of the favorable states) should be able to give a successful start to a sequoia that may live for many generations.



Giant sequoia at the Tyler Arboretum near Philadelphia, Pennsylvania (page 115)

Courtesy of Tyler Arboretum



Are diseases to ravage oak and birch forests such as this? More of our trees are lost to diseases and insects than to fire

Diseases of Shade and Forest Trees

A glance at the problem

Lee M. Hutchins

THE threat of tree diseases is ever present. From the time a tree emerges as a seedling to the end of its useful life it is subject to diseases that reduce its growth, destroy its usefulness, or cause its death. Diseases and insects together cause greater losses than fire in the forest.

Origins

Trees must contend not only with native diseases but with introduced diseases as well. Man has imported many exotic tree species and in so doing has brought in new diseases, such as chestnut blight [see page 138 of this issue] and white pine blister rust [page 149]. Dutch elm disease was brought into the United States from Europe on elm logs intended for veneer [page 131].

Causes

Tree diseases are caused by bacteria, fungi, and viruses, and by such factors as unfavorable weather conditions, poor site and drainage, and nutritional deficiencies. Fungi cause most of the major tree losses.

Direct Control

Effective control of tree diseases is commonly based on knowledge of the cause of the disease and the means of spread. Direct control methods include the use of sprays, dusts, and soil treatments; the removal and destruction of affected trees or parts; and the removal of alternate hosts.

Sprays and soil treatments are used in the nursery to protect the seedlings

from diseases. Sprays and dusts are used to combat leaf spots and to destroy the insect carriers of tree diseases.

White pine blister rust was brought in from Europe on pine seedlings. This disease is being controlled effectively by eradicating *Ribes* plants (currants and gooseberries), which are the alternate hosts of the fungus. Too, resistant white pines have been selected and tested. [See the article on page 149 of this issue.]

A dangerous disease that has been introduced into a locality and is known to have limited distribution can sometimes be eradicated. Some years ago European larch canker was discovered in a limited area in Massachusetts. Thorough eradication appears to have eliminated this disease problem.

Indirect Control

Indirect control methods are used if a disease has become well established and widespread. Sound timber management practices can reduce disease losses in the forest. The prevention of fire is an important indirect control measure—decay fungi frequently enter trees through fire wounds. Other methods involve the proper timing of cutting, the control of stand composition for mixtures of tree species instead of pure stands, and the development and use of disease-resistant varieties.

The mimosa wilt is a serious tree disease in the Southeast. Selections resistant to the wilt are now being propagated and will soon be available through commercial channels [page 144].

Elms resistant to the Dutch elm disease have been selected and tested [page 131 of this issue], but the problem is complicated by a virus disease, phloem necrosis, which apparently is native. Elms

resistant to phloem necrosis have also been selected and tested [page 129].

An apparently native disease of unknown cause is the very destructive little-leaf disease of shortleaf pine. The spread and intensification of this disease have been determined, and salvage recommendations have made it possible to harvest diseased pine while it is still usable [page 153].

Prospects

Study of forest-tree diseases is relatively new in this country. Since the turn of the century, more than twenty-five new forest-tree diseases, some of them introduced and some apparently native,

have been discovered here. Through research, much progress has been made in our understanding of the cause and nature of these diseases. Nevertheless, much remains to be done and forest pathologists are continuing their studies. We can confidently expect that such investigations will result in more effective disease-control methods and will reduce the staggering losses to forest and shade trees.

The wilt disease of oaks is one of the serious and still relatively new tree-loss problems that must be solved.

[An article on disease and insect pests in the home orchard appeared in *PLANTS & GARDENS*, Autumn, 1950.—Ed.]



A fine specimen of white oak (*Quercus alba*), with trunk 17 feet in circumference at 4 feet above the ground

The Threat of Oak Wilt

And the hope for its defeat

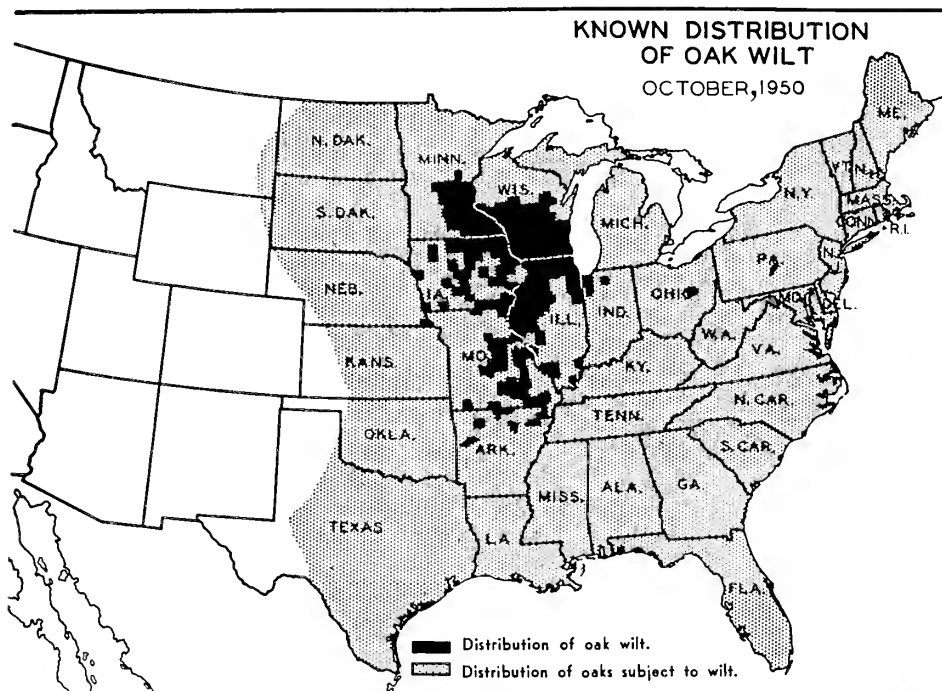
J. E. Kuntz and A. J. Riker

DURING the past decade a serious disease of oak trees called "oak wilt" has spread alarmingly among shade and woodland trees in various states east of the Great Plains. The disease has been known for some years in Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The annual reduction in timber harvest and value is substantial, even though immediate salvage of mature wilting trees may be possible. More recently, oak wilt has been discovered in Arkansas, Indiana, Kansas, Ohio, Nebraska, and Pennsylvania. Undoubtedly further search will reveal its presence both in new areas within these states and in neighboring states.

Oaks are Exceedingly Valuable

The recent discovery of the oak wilt disease in these extensive southern and eastern forests emphasizes the threat of the disease to timber areas of immense commercial value, to say nothing of the oaks that shade our streets and lawns. Oaks comprise about one third of the total volume of hardwood saw timber in the eastern United States. For example, the United States Forest Service estimates that a total of 41,880 million board feet of oak saw timber stand in Kentucky, Tennessee, Missouri, Arkansas, Mississippi, Louisiana, and eastern Texas. In addition, Pennsylvania, West Virginia, and Virginia have some 21,039 million board feet.

Oaks provide the most important hardwood lumber of the United States. Oak wood supports major industries that use



Courtesy of Department of Plant Pathology, University of Wisconsin



Photos and diagram by courtesy of Department of Plant Pathology, University of Wisconsin

Black and red oaks killed by oak wilt on the lawn of a residence in Madison, Wisconsin

it for many purposes, including lumber, cooperage, cross ties, flooring, and heavy timbers.

Aesthetic values become conspicuous when shade trees die in lawns and parks. Frequently people pay premium prices for building sites in oak woods—only to have their trees killed one after another by the oak wilt. Removal and replacement of wilted trees are usually difficult, costly, and unsatisfactory. Parks may be changed completely in character. For example, at Devil's Lake State Park in Wisconsin more than 100 oaks have been removed annually during recent years. Oak wilt has almost ruined Nob Hill State Park in Iowa, where thousands of oaks have been killed.

Is Oak Wilt New?

The first description of oak wilt as a definite disease was made in 1942. The exact time, place, and manner of its ori-

gin remain a mystery, however. Evidence is clear that it was active in 1929. Possibly it has been present for a great many years but has been confused with injury caused by certain other diseases or by drought or insects. Whether or not it is new does not change its present importance, its rapid spread, and its increasing significance.

All Oaks are Susceptible

Unfortunately, all species of oaks so far subjected to natural infection or tested by artificial inoculation have proved susceptible to oak wilt. However, some kinds of oak trees are more tolerant of oak wilt than others. In addition to oaks, naturally infected Chinese chestnuts having oak wilt symptoms have been found to harbor the causal fungus of oak wilt. The susceptibility of the Chinese chestnut to the oak wilt may aggravate the problem of developing disease-resistant chestnuts. [See page 138 of this issue.]

Appearance of Oak Wilt

On red and black oaks, the first symptom is a slight curling and dull paling of the older leaves, usually near the top of the tree or toward the tips of lateral branches. Affected leaves gradually become bronze to brown, progressively from the tip or margins toward the base. The mature leaves are usually so stiff that they remain rigid even when dying. They may fall during any of the symptom stages. Young leaves, however, wilt and droop conspicuously. Usually, the swollen base of the leaf stalk (*petiole*) becomes dark. Premature defoliation of a lawn tree may necessitate repeated raking of leaves. Sometimes, however, defoliation may be slight and most of the dead leaves may remain on the tree.

Secondary sucker growths with dense clusters of large, succulent leaves often appear on the trunk and larger branches after the original leaves have wilted. False hopes of tree recovery, however, soon fade. In a few weeks this new growth in turn wilts and dies.

The leaf symptoms progress rapidly over the entire crown of the tree, commonly affecting the lower branches last. Usually discoloration, dying, and defoliation are complete within a week or two. Examination of the annual rings (in a cross section of the trunk) indicates normal growth of the tree up to the time of its death (see photo on next page).

External foliage symptoms are sometimes accompanied by brown to black discoloration in the outermost part of the wood—just under the bark. Peeling back the bark on twigs and branches sometimes reveals diffuse tanning or stippling or irregular streaking. Such discoloration may be absent, however, especially if infection has been rapid; and when present, it should not be confused with discoloration from other causes.

All symptom stages have been found from the latter part of May until late September when natural autumn coloration masks the leaf symptoms. Trees of the red oak group usually die during the same summer in which the first symptoms appear, but occasionally an infected tree lives over winter. In such cases, the larger branches leaf out partially the following spring, only to die soon afterwards.

No tree of the red oak group has been known to withstand the disease, or once infected, to recover. Hence there appears little immediate hope of finding a naturally resistant selection within this group. Stump sprouts from wilted trees likewise die, so that normal regeneration is prevented.

On white and bur oaks, the symptoms differ somewhat from those on black and red oaks. Usually an entire white oak tree does not wilt at once. Twigs with dead and dying branches are often scattered throughout the crown. Some branches show leaf symptoms while others remain outwardly healthy throughout the season. Many trees show dieback of the upper branches in varying degrees, so that eventually a stag-headed appearance results. Twig dieback and general stag-heading, however, may result from other

causes. Infected trees may survive for some years. For this reason, many people insist on allowing infected bur and white oaks to remain, although they conscientiously remove the obviously dying red and black oaks.

A Fungus Causes Oak Wilt

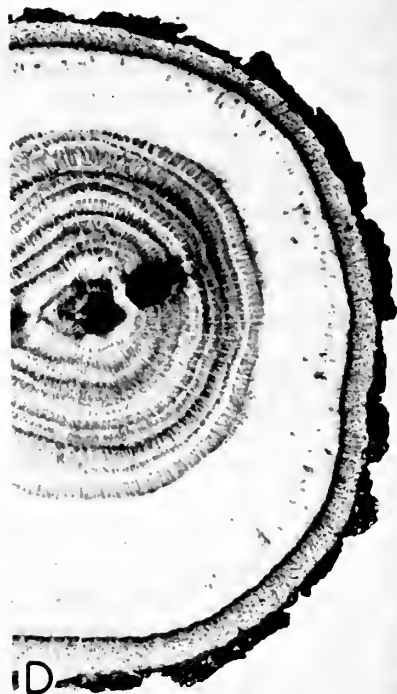
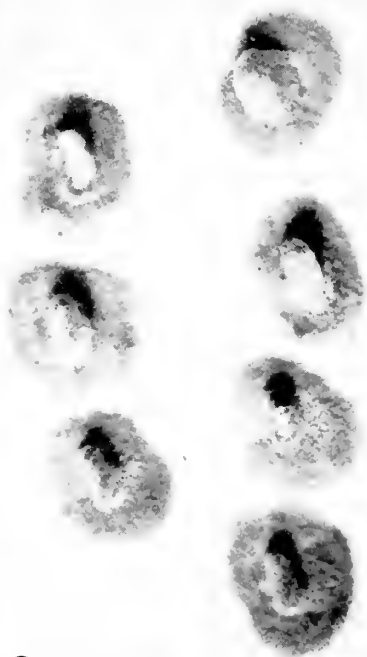
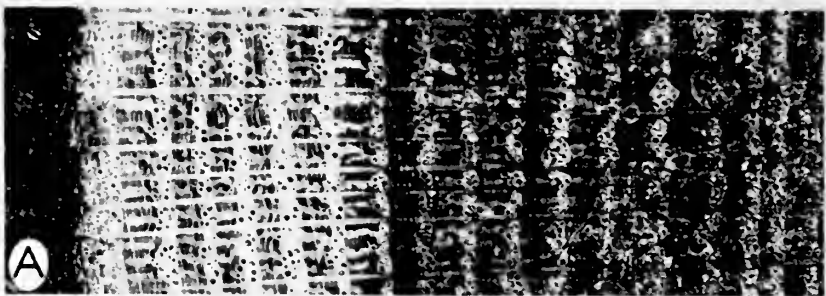
The oak wilt disease is incited by an extremely virulent fungus named *Chalara quercina*. The fungus has been observed in and isolated from the water-conducting tubes of the outermost (or youngest) one or two annual rings. Symptoms may follow artificial inoculations into the woody conducting tissue within three to six weeks. Once infection has taken place, the spread of the fungus throughout red oak trees is rapid.

The fungus lives from one season to the next in infected trees: for at least a year in the roots of red and black oaks, and for a much longer time in the crowns of white and bur oaks.

Spread from Tree to Tree

Oak wilt spreads in at least two different ways. In one case it jumps a considerable distance—anywhere from a few hundred yards to more than a mile—into previously healthy trees. How this happens remains to be discovered. Among the possible carriers suspected are birds, various insects, and rodents.

A second type of spread is the progressive movement in local areas from diseased to adjacent healthy trees. Ordinarily, starting from a single infected tree—in many cases one of the tallest trees of the stand—the disease gradually progresses from tree to tree in a more or less irregularly concentric pattern. Radial spread outward from the infection center usually involves, in any one season, only one or two trees in each direction. After a few years an active wilt area contains dead and decaying skeletons at the center, surrounded by recently killed trees with loosening bark. An outer border includes dying trees in various stages of wilt. Only rarely do black or red oaks escape this outward invasion. Moreover, if passed by, red and



From Phytopathology, July, 1944, page 641

black oaks usually become infected within a few years. On the other hand, bur and white oaks growing in mixed stands often escape infection and usually are the only oaks remaining in a wilt area.

This latter tree-to-tree type of local spread has been studied intensively. Digging and washing out of tree root systems have revealed abundant and widespread natural underground grafting of oak roots. As a result of such grafting, trees in a dense stand are interconnected. Water, dyes, poisons, and (probably most important) the spores of the oak wilt fungus readily move through these grafts. Movement through these grafts, from tree to tree of the same species, and from one species of oak to another, has been traced with a Geiger counter using radioactive isotopes. The movement of these isotopes, or "hot" solutions, closely corresponds to the development and spread of oak wilt. Root grafts between individuals of a species of the red oak group were found to be numerous; grafts between individuals of the white oak group, only occasional; and grafts between two individuals, one belonging to each of these two different groups, were found to be rare.

Normally, such graft unions can benefit the tree community, but they are harmful when oak wilt strikes. Through these underground channels, the fungus has direct pipelines from tree to tree.

No correlation has appeared between the severity of the disease or its rate of spread and differences in soil or site.

Local Control Seems Promising

With the discovery of natural root grafting in oak stands and the passage of the oak wilt fungus through these connections, several possibilities for local control have appeared. Immediate re-



Natural underground grafts between the roots of two black oaks. Roots at angle to main root are those of another tree

moval of each wilting tree over a period of years has retarded the disease in eleven out of eighteen Wisconsin study plots. In four of these plots no new wilt has appeared for two years. Where single newly wilting trees have been poisoned, no spread has occurred in any

←

A: part of a cross section of a tree killed by oak wilt, showing that growth is normal until the time of death. B: an infected black oak twig with bark removed, showing the discoloration that sometimes but not always appears. C: growth of the oak wilt fungus from chips of diseased wood after seven days at room temperature on malt agar. D: part of a cross section of black oak stem showing the discoloration that sometimes but not always appears in the outer wood, just under the bark

of six 1-year-old plots or three 2-year-old plots.

In woodland areas, where individual trees were of relatively low value, poisoning healthy trees bordering a wilt area has been tried and has prevented further local spread in twelve plots, of which six were 4 years old.

For lawns and parks, where each individual tree was of great value, the severing of all root connections, both mechanically and chemically, has been tried. In ten plots, trenching or cutting between wilting and healthy trees has prevented further spread, in experiments started two years ago.

For trees in the white oak group, less drastic measures are being studied. Careful and rigorous pruning of all wilting branches has been reported to prolong the life of an occasional tree. How dependable this may be remains to be determined. Meanwhile, records show that the oak wilt fungus has remained dormant in wood of infected white oaks for several years.

For additional information see:

1. Oak wilt—a serious disease in Iowa, by S. M. Dietz and Roy A. Young. In Iowa Agricultural Experiment Station Bulletin P91, 1948.
2. *Chalara quercina* n.sp., the cause of oak wilt, by B. W. Henry. In Phytopathology, July, 1944, page 631.
3. Oak wilt: its significance, symptoms, and cause, by B. W. Henry, C. S. Moses, C. Audrey Richards, and A. J. Riker. In Phytopathology, July, 1944, page 636.
4. Wound infection of oak trees with *Chalara quercina* and its distribution within the host, by B. W. Henry and A. J. Riker. In Phytopathology, Oct., 1947, page 735.
5. Oak wilt in Wisconsin, by J. E. Kuntz and A. J. Riker. In Wisconsin Agricultural Experiment Station Stencil Bulletin 9, 1950. [Literature cited.]
6. Studies on oak wilt, caused by *Chalara quercina*, by Roy A. Young. In Phytopathology, June, 1949, page 425.

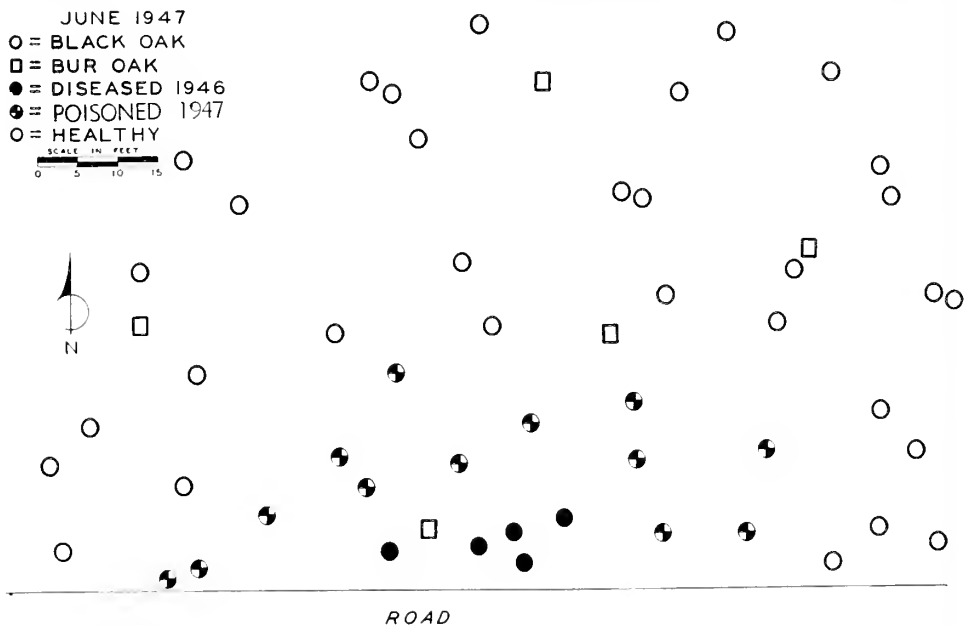


Diagram of an oak wilt area in which the local tree-to-tree spread has been stopped for four years by poisoning the adjacent healthy trees

In fifteen states

Phloem Necrosis of Elm

*May be prevented by control
of leafhoppers*

W. L. Baker and Curtis May

IN the Midwest two killing elm diseases are now present. One of these, the fungus-caused Dutch elm disease, is discussed in another article in this issue (page 131). The other, called phloem necrosis, is caused by a virus. This disease affects the American elm (*Ulmus americana*) and the winged elm (*U. alata*). Phloem necrosis has killed scores of thousands of American elms in cities and in the countryside. The disease has been reported from fifteen states—namely, West Virginia, Ohio, Indiana, Kentucky, Illinois, Iowa, Missouri, Nebraska, Kansas, Oklahoma, Arkansas, Tennessee, Mississippi, Alabama, and Georgia.

Symptoms

Leaf symptoms of phloem necrosis can be confused with those of Dutch elm disease, but there are other characteristic symptoms that distinguish the two diseases, and no laboratory test is required to diagnose a case of phloem necrosis. The name of the disease alludes to one of these symptoms—the death of the inner bark, or *phloem* tissue. Beginning at the base of the trunk and extending upward for varying distances, the inner side of the bark of a tree affected with the disease is discolored. The discoloration usually appears as a diffused butter Scotch yellow, which may be flecked with brown or black. In later stages the inner bark is dark brown. When the disease is in the butter Scotch-yellow stage, a faint odor of wintergreen can be detected when fragments of the discolored bark are held for a few seconds in the tightly closed fist, or

placed in a small capped container and then sniffed. Trees affected with Dutch elm disease do not develop the wintergreen odor and the inner bark is not discolored. The inner bark of a healthy elm is white or almost colorless.

Foliage symptoms of phloem necrosis include wilting, drying, or yellowing and falling of leaves, followed by death of



Courtesy of U. S. Dept. of Agriculture

Discoloration produced by phloem necrosis is confined to the thin bark layer in contact with the wood. The color is yellow to typical butter Scotch, sometimes flecked with brown or black

the tree. Some affected trees may leaf out thinly and weakly in the spring and then die before a full crop of leaves or much new growth is formed. Some show mild symptoms of disease late in the summer. These trees usually die soon after leafing out the following spring. An elm that seems to carry a full complement of leaves but lets more light through the foliage than it should, may have phloem necrosis. The leaves of diseased trees often fold upward on the midrib and thus present less obstruction to the passage of light through the crown than normal leaves. For diagnosis, however, the final test is the discoloration of the phloem.

Spread

The virus causing phloem necrosis is spread by the leafhopper *Scaphoideus luteolus*. Recent investigations have demonstrated that when these insects feed upon affected trees they can suck in the virus in the plant juices and then can infect healthy trees when they feed upon the leaves or tender new growth.

The eggs of this leafhopper are laid in the outer bark of living elm trees and overwinter there. The eggs hatch in the spring and the young nymphs emerge about the time the first leaves develop. In five to seven weeks the nymphs transform into adults, which are present throughout the summer.

Control

Spraying with DDT to control these leafhoppers is the most effective known method of protecting healthy American elms from phloem necrosis. An emulsion spray is not injurious to elm trees and remains effective a long time. Two applications should be made in one season—the first, in May in the South and in June in the North; and the second, one to two months later. Either a hydraulic sprayer or a mist blower may be used.

With a hydraulic sprayer, an emulsion

of 1-per cent DDT is used. An emulsifiable concentrate is prepared by dissolving 16 pounds of technical DDT in 4 gallons of industrial-grade xylene, and adding 1 pint of Triton X-100 (an arylalkyl polyether alcohol). To this concentrate 20 to 30 gallons of water are added, with constant agitation; and as soon as a milky-white emulsion forms, more water is added to make 200 gallons of spray.

With a mist blower an emulsion containing 6 per cent of DDT is used. An emulsifiable concentrate is prepared by dissolving 20 pounds of technical DDT in 5 gallons of industrial-grade xylene and 2½ gallons of white oil, and adding 1¼ pints of Triton X-100. To this concentrate about 10 gallons of water are added, with agitation; and when a milky-white emulsion forms, more water is added to make 40 gallons of spray. Treatment dates are the same as those recommended for the 1-per cent emulsion applied with hydraulic equipment.

Removal of trees killed by phloem necrosis does not arrest the spread of the disease. However, in areas where phloem necrosis, Dutch elm disease, and the European elm bark beetle (which spreads the Dutch elm disease) are present, the elms killed by phloem necrosis commonly become infested with the bark beetles. These dead elms should be disposed of or sprayed with DDT to prevent emergence of the beetles.

Resistant Trees

American elms that are resistant to phloem necrosis have been discovered. About half of the seedlings from some trees resistant to phloem necrosis have shown high resistance to the disease. Unfortunately no American elms have been found that are resistant to both Dutch elm disease and phloem necrosis. The search for them is continuing; but until such trees are found, reliance for protection against the diseases must be placed in spray treatments.



Courtesy of the author

Early foliage symptoms of Dutch elm disease

Dutch Elm Disease

Calls for strenuous control efforts

Rush P. Marshall

FOR twenty years we have lived with the Dutch elm disease. What have been our experiences with it? What will its story be during the next two decades?

This disease, which attacks all species and varieties of native North American elms, was brought to this country together with an insect carrier, in elm burls from Europe. The first outbreaks were discovered in 1930. Another European

introduction of the disease, this time opening a new center of infection in Canada, is of more recent origin.

During the score of years since its unfortunate entry, the Dutch elm disease has spread rapidly. In locations where it has become established, much damage has been done. Infection now occurs at least sporadically in approximately half of the area of the natural range of our elms.

Within the center of this area of Dutch elm infection, a native American virus disease of elms, phloem necrosis,



A healthy American elm is a tree asset almost unmatched in the shade tree realm

burns like a terrible fire [see page 129 of this issue]. Although these two disorders are unrelated, their simultaneous destructive attacks have done much to hinder control which might have been given either outbreak had it occurred

singly. Because of this dual disease attack, property owners, the tree men who would serve them, and the officials of government and state have valiantly struggled under a heartbreaking burden of discouragement.

Cause

The causal fungus of the Dutch elm disease is referred to as *Graphium ulmi* or (less commonly) *Ceratostomella ulmi*. A closely related species of this fungus is one which causes blue stain of lumber.

With the exception of passage from tree to tree through natural root grafts, the fungus is dependent on bark beetles for transmittal. In our country both the European elm bark beetle (*Scolytus multistriatus*) and the American elm bark beetle (*Hylurgopinus rufipes*) serve as carriers. Not only do they transmit the disease—they are fully capable of killing trees without its help. Both of these small insects roughly resemble in size and form the all-too-familiar flea beetles which perforate the leaves of our tomato plants. Adult bark beetles make brood galleries in the cambium layer of elms [the delicate vital tissue from which new bark and wood are formed], selecting (when possible) weakened trees or branches. Eggs are laid within these galleries. From these brood galleries

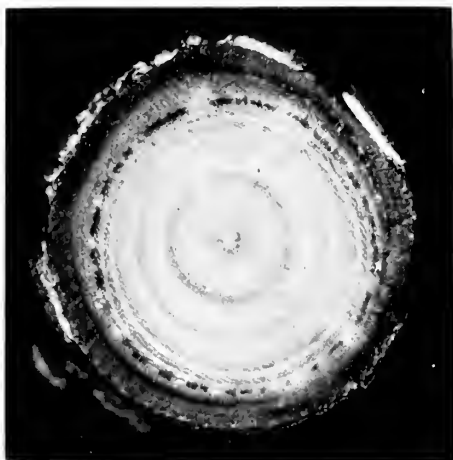
numerous smaller feeding galleries run out roughly at right angles on either side. The brood gallery of the European elm bark beetle runs parallel with the grain of the wood, while that of the native elm bark beetle runs at right angles to the grain. This sculpturing shows clearly when loose dead bark is removed.

Emerging from such galleries, the beetles first feed on the tender bark of young twig crotches. If the feeding beetles come from a tree infected with Dutch elm disease, they are capable of inoculating these feeding punctures with spores of the causal fungus carried on their bodies. These spores cause infection of the conducting system through which liquids pass in the tree. Through these tubelike channels the fungus goes rapidly downward into larger wood. The fungus produces a toxin, or poison, which causes the familiar symptoms of the Dutch elm disease—wilting of the leaves and curling of the tiny twig tips. This infection gives the conducting tubes a brown discoloration, which is easily seen when a cut into the wood is made. Similar discoloration is produced by several other diseases, and so a positive determination of the cause must be through



Photos courtesy of the author

Elm branch with bark removed to show sculpturing (or galleries) of European elm bark beetle, which carries Dutch elm disease. About natural size



Cross section of an elm branch showing discoloration of the outer wood (just under the bark), caused by the Dutch elm disease fungus. About 3 times natural size

special fungus culture technique in the laboratory.

Control

Because the fungus lives within the conducting system, control is not possible by means of ordinary fungicidal sprays applied to the outer parts of the tree. Hence, efforts to check or eliminate the carrier beetles provide the most practical means of stopping the spread of the disease.

Sanitation in promptly pruning out and burning infested wood or stripping off and burning the bark from the larger felled trunks and branches results in the destruction of myriads of elm bark beetles.

Spraying with strong solutions of DDT just prior to the emergence of the beetles in early spring has been suggested as an effective means of guarding our trees from infection; for if the



Elm logs (from diseased trees) on city dumps release millions of beetles—carriers of Dutch elm disease

work is done properly, beetles feeding in the crotches are killed before they have time to inoculate the trees. Repetition of this spray is sometimes advised to check beetles emerging in midsummer.

Proper general care. In carrying out their activities in the inner bark, these beetles must either kill the wood by girdling or be crushed by the pressure of the newly developing growth. Hence any measures which can assure active normal growth of the tree are helpful in checking the beetles. These measures may include supplying the tree with ample food-building substances; providing adequate water, as far as is possible; and guarding the tree against serious defoliation by cankerworms or elm leaf beetles or those fungi that cause premature leaf fall.

Chemotherapy. Numerous attempts have been made to combat the Dutch elm disease more directly by introducing various substances into the tree.

Two such experimental treatments by

Prompt removal and burning of this tree dying of Dutch elm disease would destroy the beetle carriers before they spread the infection



Photos courtesy of the author



Injection of disease-controlling chemicals into the soil, to be taken up by the roots

chemotherapy which have been widely tried involve the use of oxyquinoline benzoate (as recommended by the Connecticut Agricultural Experiment Station) and Carolate (as recommended by the Rhode Island Agricultural Experiment Station). The two are alike in that they are designed to give added protection to especially valuable trees, over and above that provided by the previously mentioned sanitation, spraying, and proper care; in that they are put into the soil for root uptake; and in that they afford the tree an approximately 50 per cent greater chance of escaping Dutch elm disease than if such treatment had not been given.

Prospects

What is the future of America's elms? The passing of another score of years will tell us much that we cannot now predict. We strongly believe, however, that unless strenuous and expedient meas-

Too late for removal to help control the disease. From these elms killed by the Dutch elm disease the bark beetles have already emerged and flown to adjacent healthy elms

ures are taken, there can only be more marked spread of the Dutch elm disease in the future than in the past. For making any prophecy about our elms, a tyro in plant diseases is as well qualified as an expert. Before drawing conclusions, anyone should go out and look over both neglected and well cared-for elms. Having looked, he may possibly recommend continued planting of elms where they can be assured adequate care. Certainly no one will recommend the abandonment of the elm to doom without full battle both by what we now know and by the much there is still time to learn.

Whatever we now strive to accomplish must be undertaken in the face of a more disrupting conflagration than that of the phloem necrosis. The need of checking a fire which threatens our freedoms dictates only the most rational use of labor and material even in the service of America's beloved elms.



Diseases and Pests of Dogwood Trees

And how to deal with them

Cynthia Westcott

SEVERAL wood-boring insects attack flowering dogwood. The **dogwood borer** (*Thamnosphinx scitula*) is a whitish caterpillar, $\frac{1}{2}$ inch long, larva of a clear-wing moth. The adult, emerging in late spring or summer, lays eggs on the bark, usually in roughened areas. On hatching, the larvae make irregular burrows under the bark on the main trunk, at the base of limbs, or at the edges of wounds or scars. The tunnels are chiefly in the cambium [the delicate and vital tissue from which new wood and bark are formed]. An infested area may be 2 feet long, or more, and contain as many as fifty borers. Infested limbs may die, and sometimes a whole young tree. Dead bark should be cut away, the borers cut out with a sharp knife, and the wounds painted with shellac or a tree-wound dressing. DDT is an excellent borer preventive and will also take care of early infestations. The wettable powder is mixed with water (at a strength several times greater than that used for foliage spraying) and applied to the trunk with a brush.

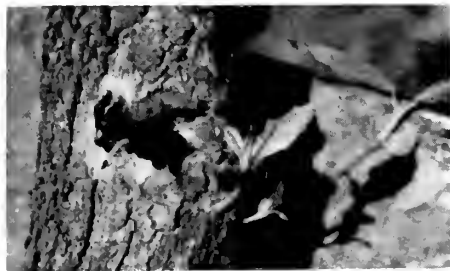
The **flat-headed apple tree borer** (*Chrysobothris femorata*) attacks dogwood trees that are newly transplanted and those weakened by drought. The trunks should be kept wrapped with burlap or special spirally wound paper, from ground to branches, for the first two years after transplanting. General health, promoted by proper feeding and watering, will help the trees resist this borer.

The **dogwood twig borer** (*Oberia tripunctata*) is a lemon-yellow grub, $\frac{3}{4}$ inch long, found in terminal twigs. The adult, a small cylindrical beetle, girdles a small branch near the tip and lays an egg under the bark just behind the girdle or between two girdles. The grub tunnels down the twig, expelling its borings through a series of small holes. Wilting twigs should be cut off below the grub.

Spindle-shaped or tubular swellings, $\frac{1}{2}$ to 1 inch long, formed at the tips and along the sides of small twigs, are caused by a **midge** (*Mycodiplosis alternata*). Tiny legless maggots come out of the galls in late summer, and minute two-winged flies lay eggs on the bark in the spring. Another midge (*Cecidomyia* sp.) makes a green, red-tinted bud gall. On isolated trees it may be practical to cut off and burn the galls before the maggots have



Part of injury caused by dogwood borers, which usually girdle either the main trunk or the branches



Other side of same dogwood trunk, showing continuation of borer injury. Bark cut away to show single borer

left in the summer. A DDT spray in the spring may help to prevent egg-laying.

The **dogwood scale** (*Chionaspis corni*) is said to be increasing. It is quite possible that spraying with DDT to control other pests is killing the natural enemies of the scale. The females are grayish and pear-shaped, the males pure white and narrow. In severe infestations the bark appears white and scurfy. A dormant oil spray should be used in the spring before new growth starts.

Diseases

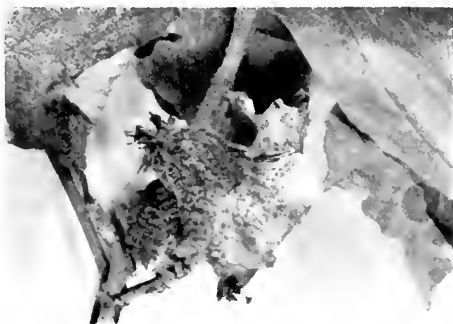
Crown canker, or collar rot, especially prevalent on Long Island, is the most serious disease of dogwoods. The fungus (*Phytophthora cactorum*) is the same as that causing bleeding canker of maple and elm, and dieback of rhododendron. It lives in the soil and enters through wounds made by tools in transplanting or by lawn mowers or cultivators. Affected trees have smaller, lighter green leaves than normal trees and these turn red prematurely in late summer. Twigs and large branches die; and a sunken area develops on the lower trunk, with discoloration of inner bark, cambium, and sapwood. When the canker extends completely around the base of the trunk the tree dies. Transplanting should be done carefully; the trunk should be protected against lawn mowers by some sort of guard; a new tree should not be planted in the same spot where there has been a death from crown canker.

Spot anthracnose, a rather spectacular leaf and flower disease (due to *Elsinoë corni*) has been found from Maryland southwards in recent years. It was first reported from Georgia, in 1939. A single leaf may have upwards of a hundred small, circular to irregular spots, with reddish gray margins surrounding light centers. Numerous small tan spots with purple to brown borders appear on the showy floral bracts [which are often thought of as the petals]. The disease is most serious in a wet spring. One or more properly timed copper sprays will reduce the infection but may not be practical.



Dogwood galls caused by midges

In very wet seasons in the New York area there is another spectacular disease, a gray-mold **blight of fading flowers** (due to *Botrytis cinerea*) followed by a **leaf blight** caused by infected flower parts clinging to the moist leaves instead of dropping cleanly as usual. There is little permanent damage and the expense of control measures is probably not justified.



Courtesy of the author

Dogwood leaf blight

Blight Resistance in the Chestnut

Breeding work to replace the American chestnut

Arthur Harmount Graves

WHEN a nursery advertisement announces "blight-resistant" chestnut trees for sale, this does not mean that the trees are immune to blight but rather that the fungus causing the blight advances in the healthy tissues with unusual slowness. Eventually it may stop altogether and the lesion may heal over in time. This is what actually happens with many Chinese chestnuts. They may and probably will live to justify their existence and yield good crops. With the Japanese species the process of healing is slower, but there is great variation:



American chestnut tree in the Great Smoky Mountains near Knoxville, Tennessee. Two feet in diameter at breast height; still healthy in 1927, now dead

some individuals are very resistant to the advances of the parasite, others much less so.

The native or American chestnut usually shows very little resistance, at least in the parts above ground; this is why the deadly parasitic fungus (*Endothia parasitica*) which sneaked into this country sometime before 1900, has made such a clean sweep of the American chestnut. It looks as if Asia, whence the fungus came, had been its home for a very long period, so long that all of the individuals of Chinese and Japanese chestnut which were not resistant have been wiped out; and the more resistant stock which was left has gradually increased its resistance through the ages by the process of elimination of the unfit.

Materials for Breeding

We are offered here in America some excellent tools to work with in the attempt to construct by plant breeding a blight-resistant chestnut to replace the now practically defunct American one. We have the Chinese chestnut, a comparatively low-growing but very blight-resistant kind; the Japanese, less resistant and also low-growing; and finally, the remnants of the old native American chestnut, consisting mostly of sprouts from the root collar of otherwise defunct trees. These sprouts often live long enough to blossom and bear nuts; therefore, the valuable qualities of the original tall, erect, American chestnut are still available for breeding.

It would seem a foregone conclusion that (given sufficient time) it will be feasible to unite the good characteristics of the American chestnut—tall, erect, rapid growth, and sweet though comparatively small nuts—with those of the oriental kinds—disease resistance and larger nuts.

Requisites for Breeding

The most important requisites for success are persistence and time, seasoned with a measure of good judgment. Breeding of forest trees is a slow process; in the case of the chestnut, from six to ten years are usually required for a single generation. With vegetables and flowers the conditions are far simpler; at least one, and sometimes two or three generations can be secured in a single year. But the potential rewards of forest tree breeding are so vast that we should begin now to improve our forest trees even though we may not live to see all the results.

Breeding Work

In 1930 the Brooklyn Botanic Garden commenced breeding for a blight-resistant timber chestnut. A few years before this the Division of Forest Pathology of the United States Department of Agriculture had launched a similar program. In 1947 the Connecticut Agricultural Experiment Station, long known for its interest in the chestnut tree, took over the work. The program is now going forward chiefly at Hamden, at the Sleeping Giant Plantation; at the Experiment Station Farm at Redding Ridge; and at the White Memorial Foundation at Litchfield. Eight test plantations under the supervision of Dr. J. D. Diller of the Division of Forest Pathology, United States Department of Agriculture, have been established in various parts of the eastern United States, the home of the American chestnut. Many of our hybrids (crosses of Chinese, Japanese, and American chestnut trees) are now growing in these test plots, along with those of the Department of Agriculture, and give promise of making excellent substitutes for the old American trees. Through our crossing experiments we have developed, up to this year, 8231 hybrid nuts. About twelve hundred hybrid trees resulting from these nuts are now growing in the various plantations.



Blight-killed area (canker) in the bark at the base of a Japanese chestnut. The fungus has been stopped in its advance: a roll of healthy callus (healing tissue) has been formed around the canker; such healthy tissue shows plainly at the base on the left; above and elsewhere it is covered by dead outer bark. A vigorous root (right center) and smaller ones (at the right of it) have grown down from the upper edge of the diseased area. This tree is now a healthy individual

Cause of Resistance

But what of the cause or causes of blight resistance? Why is the Chinese chestnut most resistant of all? From the beginning I have been convinced that resistance is in some way connected with the presence of tannin in the bark. Now, Hans Nienstaedt, a graduate of the Yale School of Forestry, working at the Connecticut Experiment Station, finds that there are several kinds of organic substances present in what we call "tannin" in chestnut bark. One of these occurs rather abundantly in Chinese, less so in Japanese, and not at all or very little in American bark, and appears to be the critical substance.

The whole matter—the occurrence of tannins in chestnut bark and their relation to disease resistance, as well as other factors in the problem—forms the subject of a doctor's dissertation to be presented this year at Yale University by Mr. Nienstaedt.



Photos courtesy U. S. Dept. of Agriculture

The Lafayette poplar near Geneva, New York, probably the biggest native poplar in the Northeast

Breeding Poplars for Disease Resistance

The need and the method

Ernst J. Schreiner

THERE is a fine old poplar on the outskirts of Geneva, New York, whose historical significance is witnessed by a small plaque: "This tree shades the spot where on June 8, 1825, General Lafayette was welcomed by the children, militia, and citizens of Geneva." Although the plaque does not say so, this tree could have provided refreshing shade for the General and his party on that June day, 126 years ago.

The trunk of the Lafayette tree is 7 feet in diameter at 4½ feet above the ground, a girth of 25 feet! Such size, on

an upland site, probably represents at least 150 years of growth. There are many other native poplars throughout the country that have passed the century mark. Although most of us think of poplars as short-lived trees, these centenarians should help to refute the idea that poplars die of physiological old age much earlier than other trees.

If we call trees short-lived because they usually die of disease or of a combination of deleterious environmental factors before they reach an appreciable age, then poplars are short-lived. So is our native American chestnut by this definition; since the introduction of the chestnut blight, chestnut sprouts and seedlings

have been doomed to a very short life indeed. [See page 138 of this issue.]

Poplar Diseases

Poplars are extremely susceptible to disease. In the United States, serious canker diseases are caused by four different fungi,* and there are other diseases that have not yet been studied and classified. There are also minor diseases such as the common poplar leaf rust and various leaf spots that may reduce the vitality of infected trees. Europe and Asia also have several serious poplar diseases that have not yet been reported in this country.

Breeding

Why bother with such sickly trees? Because hybrid poplars are outstanding in their rapid growth, among forest trees adaptable to the continental United States; and because the variation among poplar species and varieties, in susceptibility to specific diseases, offers excellent opportunity for breeding hybrid poplars that are both rapid-growing and disease resistant.

More than thirteen thousand hybrid seedlings, representing ninety-nine cross combinations among thirty-four different types of poplars, were produced between 1924 and 1926 by the cooperative breeding project of the New York Botanical Garden and the Oxford Paper Company. In 1936 these hybrids were transferred to the Northeastern Forest Experiment Station of the United States Forest Service. The Station is now testing the best 250 of them in forest plantations throughout the northeastern region, and is continuing breeding for increased disease resistance.

Variability among Hybrids

The original hybrids have shown wide variability in disease resistance. For example, in the Maine plantations, all hybrids derived from the Chinese balsam poplar (*Populus maximowiczii*) as the

**Valsa*, *Septoria*, *Dothichyza*, and *Hymenomyces*.

female parent have been practically immune to *Melampsora* leaf rust, whereas the individual seedlings from a cross between the eastern cottonwood (*P. deltoides*) and the western balsam poplar, or black cottonwood (*P. trichocarpa*), have varied from extremely susceptible to highly resistant.

These widely diverse hybrids (with respect to inherent disease resistance) provide excellent material for the development of disease-resistant types. These poplar hybrids are sufficiently fertile to permit continued breeding for increased resistance to all major diseases. Since the controlled breeding work can be done on flowering branches in the greenhouse, crosses are possible between individual trees growing in widely scattered geographical localities.

Most poplars can be easily reproduced from cuttings [see article on propagation, page 98 of this issue]; disease-resistant hybrids can therefore be multiplied and utilized immediately without the continued breeding necessary to produce types that come true from seed. All the trees reproduced by cuttings from a selected hybrid (i.e., all the individuals of a *clone*) will be genetically identical (with a few rare exceptions).

Influence of Environment

Poplar clones which are highly resistant or even immune to a disease in one locality may not be equally resistant in some other region. Some of our best Chinese balsam poplar hybrids that have been practically immune to *Melampsora* leaf rust in the United States have been very susceptible in Europe. Extensive tests with other hybrids have shown comparable variations.

Environmental factors can influence disease resistance for better or for worse. Strictly speaking, disease resistance, in itself, is not inherited. A resistant poplar inherits only the *potentialities* for disease resistance—under certain environmental conditions. Furthermore, the disease organisms themselves are not static; they



A vigorous hybrid, very susceptible to canker disease. This 13-year-old tree reached a height of 55 feet before the top was killed by a trunk canker. (The pole in front of the tree is 18 feet long.) In spite of numerous cankers, this hybrid has grown $16\frac{1}{2}$ inches in diameter at $4\frac{1}{2}$ feet above the ground, more than an inch per year

have physiological variations with different infection potentialities.

Plan for the Future

Under these conditions a forest plantation of a single clone, or even of a small number of clones, involves an extremely serious hazard, because a clone is genetically uniform; every tree propagated by cuttings has all the weaknesses as well as all the excellence of the parent tree. Only mixed plantations of 50 to 100 disease-resistant clones, representing com-

binations of 10 to 20 parent species and varieties, can provide adequate insurance against excessive loss from as yet unknown poplar diseases and changing environmental conditions. Such a random mixture of hybrids can reduce the hazard of extensive loss from disease to a point far below the normal risk involved in a seedling plantation of a single species.

To provide disease-resistant, fast-growing poplars for the future, the forest tree breeder will have to follow the example of the crop breeders. Disease-resistant

A hybrid of the same parentage as the one on the preceding page, but more disease resistant. This tree is free from serious disease although it is growing within 75 feet of its susceptible sister hybrid



varieties of agricultural crops cannot be relied upon indefinitely; within a decade they may begin to suffer severely from apparently the same diseases to which they were originally highly resistant. Usually this represents an evolutionary change in the disease organism, hastened by extensive, or even exclusive widespread planting of the resistant variety.

The production of disease-resistant poplars (and other forest trees), like disease-resistant crop plants, must, I believe, be a continuing process. We shall

never be able to say "Here are resistant poplars; we can grow these safely in forest stands for the next hundred or two hundred years without serious trouble from disease."

And so today the Northeastern Forest Experiment Station is continuing to breed poplars for the future; crossing selected individuals of our native species with our best hybrids, to have better hybrids ready for use thirty or forty years from now, when diseases may have again caught up with our present resistant clones.

A southeastern problem

Mimosa Wilt

Hope lies in resistant strains

E. Richard Toole

THE mimosa, or silk-tree (*Albizzia julibrissin*), is a popular ornamental in the southeastern states because it is a small tree with graceful fernlike leaves and colorful flowers, and grows well on a

wide variety of sites. This tree is threatened by a destructive wilt caused by a fungus (*Fusarium oxysporum* f. *perniciosum*).

Symptoms and Cause

An epidemic dying of mimosa trees was reported to plant disease workers in the Division of Forest Pathology, United States Department of Agriculture, from Tryon, North Carolina, in 1935. These diseased trees were characterized by a rapid wilting and yellowing of the leaves and finally by death of the tree. Cutting into stems of affected plants revealed a brownish discoloration in the sapwood under the bark, and a fungus of the wilt-causing group (*Fusarium*) was readily isolated from the discolored wood.

Experiments have shown that this fungus causes mimosa wilt. The fungus inhabits the soil and enters the roots of mimosa trees, then spreads upward in the water-conducting tubes of the wood, thus causing wilting and rapid death. The spread of the fungus from one locality to another takes place by the movement of infested soil or infected trees. The mimosa wilt fungus has remained alive in air-dry soil in the laboratory for several years.

Spread

The mimosa wilt has spread rapidly and at the present time is known to occur in 107 counties in 7 States from New Jersey to Alabama. In many towns in Virginia and the Carolinas, where this disease has been particularly destructive, thousands of mimosa trees have succumbed to the disease. The situation at Morgantown, North Carolina, is typical



Photos courtesy of U. S. Dept. of Agriculture
Mimosa tree affected with wilt

of the rapid spread of the wilt. In 1943, when the wilt was first discovered there, the disease was affecting a few trees in one city block. By 1945, it had spread to 22 blocks, and by 1949 thousands of trees in 559 city blocks had been killed by mimosa wilt, leaving no area within the city free from the disease.

Tests

In order to discover whether the mimosa wilt fungus would attack other plants, and whether closely related fungi could cause mimosa wilt, a number of experiments were carried out. It was found that only a few other species of *Albizzia*, closely related to the mimosa, were susceptible to the disease and that other fungi tested did not cause mimosa wilt.

Possible Control Measures

Consideration has been given to a number of possible control measures. Because the fungus attacks through the roots and may live a long time in the soil, sprays or other external treatments to the leaves and branches would be ineffective. Applications of lime, potash, and complete fertilizers at various concentrations have had no noticeable effect on infection, but the use of soil fungicides is promising.

Preliminary results with seedling mimosa trees indicate that a fungicide such as Ferbam applied to the soil within the root zone largely prevents wilt. Although soil treatments have some disadvantages, because of occasional failure to get complete control and the necessity of frequent treatments throughout the life of the tree, they may be useful for the protection of valuable trees. Research work in soil treatment is being continued.

Best Solution

The development of wilt-resistant mimosas is considered to be the most promising solution to the problem. The search for wilt-resistant mimosa trees was start-

ed in some of the heavily wilt-infested areas but was without success for some time. Apparently healthy trees were occasionally observed in groups of wilted mimosas, but these became infected in later years. Therefore, it was necessary to make a systematic test of seedlings from a large number of mimosa trees for possible wilt resistance. In 1939, over a thousand mimosa seedlings were grown and inoculated to test wilt resistance. Twenty of these trees survived and are growing vigorously today at Tryon, North Carolina, despite repeated inoculations with the wilt fungus.

Seedlings from these resistant trees were not uniformly resistant, and so it was necessary to multiply the resistant stock by root cuttings. [See article on propagation, page 98.] Cuttings rooted from the resistant trees have proved to be resistant, while cuttings from nearby wilding trees quickly succumbed to the wilt.

The resistance tests have shown that certain mimosa trees possess a high degree of resistance to wilt, and that these may be readily propagated by root cuttings. At the present time the resistant stock is being increased, and it is hoped that in a few years wilt-resistant mimosa trees will be available to everyone through commercial channels.



With bark cut away, outer wood shows discoloration caused by the wilt fungus



Photos courtesy of U. S. Dept. of Agriculture
Saguaros in the Arizona desert

Bacterial Rot of Giant Cactus

Killing a majestic and beautiful desert plant

William C. Bryan

THE giant cactus, or saguaro (sa-wá-r-o) — *Cereus giganteus** — a unique and beautiful plant of southern Arizona and limited adjacent areas, is being affected throughout its habitat with a serious bacterial disease. Although the malady was first described about ten years ago, it had been observed to be present to a moderate degree for many years. At the time of the description of the disease, however, the severity of the epidemic seemed to have become greater than before, and during the past ten years infected plants have been dying at approxi-

mately the same rate.

Residents of southern Arizona have viewed with alarm the inroads the disease has made in some of the best saguaro forests. In a number of disease-ridden areas, there are very few young plants to replace those that have been killed. The blossom of the majestic cactus is the state flower of Arizona, and the value of the towering succulent as a scenic attraction is immeasurable. East of Tucson, Arizona, a particularly fine stand of the giants has been set aside as Saguaro National Monument, an area which attracts visitors from the world over.

Symptoms

Infection of a saguaro may begin almost anywhere in the plant (including the roots) but apparently occurs most commonly in the main trunk above

*Also known as *Carnegiea gigantea*.—Ed.



A very large saguaro (or giant cactus)—*Cereus giganteus*—in Saguaro National Monument, Tucson, Arizona

ground. The first visible signs of the bacterial rot, which is most active during the spring and summer months, are small, yellow, subepidermal spots that later become a more apparent purplish brown color while increasing in size. As the diseased areas become larger, the epidermis covering them weakens and ruptures as a result of decomposition of the

tissue or splits open near an old injury or fissure. From such openings bleeds a dark, watery-to-viscous, sour-smelling liquid—a product of decomposition of the plant's pulpy tissue.

Advanced Stages

This is the most unsightly stage in the spread of the disease through a plant,



A group of saguaros destroyed by the bacterial rot

and the stage at which numerous flies and other insects are attracted by the foul-smelling rot. Rotting tissue may slough away from the central woody-ribbed cylinder, or the trunk may be girdled or so weakened that the doomed giant will topple over in a windstorm.

Often an enlarging split in the epider-

Typical appearance of a diseased saguaro



mis covering a diseased area may permit drying of the disease pocket and temporarily arrest its spread. Woodpeckers and other desert birds may contribute to the same end by pecking away the horny epidermis, while seeking insect larvae within.

The saguaro is apparently ever on the alert: its stout spines give external protection; it seems also to employ a protective process in an "effort" to stop the disease—it produces corky cells in the tissue next the rot, just as if it were consciously endeavoring to wall out or surround the diseased area. Unfortunately, however, such an "ingenious effort" by the host does not always succeed.

Investigations

The Department of Plant Pathology of the University of Arizona initiated the studies of saguaro rot and in 1941 described a new species of bacterium, *Erwinia carnegieana*, as the causal agent.

Cooperative studies by the University of Arizona and the Division of Forest Pathology, United States Department of Agriculture, are being made to develop methods for controlling the disease.

Present experiments by the University of Arizona are directed toward control of the insect *Cactobrosis fernaldialis*, which was found by Dr. Alice M. Boyle to be capable of carrying the causal organism from diseased to healthy saguaros and spreading infection within the plants.

Associated with surveys of the rate of mortality and studies of the causal agent in saguaro rot, experiments by the Division of Forest Pathology are being carried on to determine methods for chemical protection of healthy saguaros against infection, and for arresting infections active within the plant.

At the present time, results of remedial and control measures that have been tried are mostly inconclusive. The only thing that is effective is cutting out diseased areas and allowing the cavities to dry; but this is not practical in a forest—nor does it protect the plant from future infection.

White Pine Blister Rust

A costly lesson learned

J. R. Hansbrough

THE white pines, so called because of their light-colored wood, are an important component of North American forests. They may be distinguished from all other pines by the fact that they alone bear their needlelike leaves in clusters of five. Of the eight species of white pines in North America, only three are of commercial importance, the eastern white pine (*Pinus strobus*), the western white pine (*P. monticola*), and the sugar pine (*P. lambertiana*).

Symptoms and Life Cycle

The most serious disease affecting white pines in this country is blister rust, caused by a fungus (*Cronartium ribicola*). This disease is characterized by the formation of slightly swollen, girdling cankers in the bark of the stem and branches, causing the death of those parts of the tree above or beyond the canker. On the face of the canker, blisters break open (see photo) and release innumerable spores (tiny reproductive bodies), which are orange-yellow or rust-colored, hence the common name of the disease. These spores are very light and may be carried by air currents for many miles, like fine dust particles. They are incapable of infecting other pines, however, and in order to complete the cycle of their growth they must fall on and infect the leaves of currant or gooseberry bushes (known botanically as *Ribes*). In the ensuing weeks, on the underside of infected *Ribes* leaves are then produced several other spore stages, the last of which is capable of causing new infections on

pine. These spores are very fragile and short-lived and generally cause pine infections only within 300 yards of where they are produced; but occasionally, under special conditions, they are carried alive for greater distances, up to a mile or more. They can infect only the pine needles, from which the infection spreads into the bark, where it eventually produces another canker. The important feature of this rather complicated life history is that infection cannot spread from pine to pine but must undergo an intermediate stage on currant or gooseberry leaves.



Photo by W. A. Campbell
Courtesy of U. S. Dept. of Agriculture

Blister rust canker on eastern white pine (*Pinus strobus*), showing blisters filled with orange-yellow spores



A grove of healthy white pines (*Pinus strobus*)

Control

If allowed to spread freely, blister rust is capable of eliminating or seriously impairing white pine growth over vast acreages of forest land. Fortunately, it can be controlled, and during the past three decades most of the commercially important stands of eastern white pine have been protected. A similar control program is now under way in the West, to protect the commercially important stands of western white and sugar pines there.

Blister rust can be controlled by destroying the *Ribes* plants growing within white pine stands and around them for a distance of about 300 yards, thereby preventing the pine-infecting spores from being produced near enough to the pines to cause a damaging number of infections. Occasional cankers may be produced, but if such a protective system is maintained there is no danger of excessive pine mortality.

Destruction of currant and gooseberry plants has usually been accomplished by pulling them out by the roots; carefully supervised crews of trained men have systematically covered all the area within and around the pine stands to be protected. This method has been supplemented by chemical and mechanical methods when the size and concentration of the *Ribes* plants has justified such measures.

The cost of blister rust control work has been large in the aggregate but is only a small fraction of the value of the pine stands protected. About 26 million acres of white pine forest land have been selected for protection; by 1950 the rust was under control on about 14½ million acres (55 per cent of the area), and the initial phases of control work had been applied to an additional 9 million acres. This work is conducted cooperatively under the general direction and supervision of the United States Department of Agriculture. Participating states, counties, towns, timber protective associations, lumber companies, and individual property owners have united with the Federal



Alexander Buhle

White pine killed by blister rust

Government in striving for a common goal, protection of an important natural resource, our white pines. That so much has been accomplished in so short a time is just cause for national pride.

Introduction and Spread

The actual and potential damage from blister rust to white pines is an example of the fearful toll that an introduced disease is capable of exacting. Blister rust probably is native to northern Asia; on the white pines growing there it was and is of little if any importance. From Asia the disease spread westward across Europe, where extensive plantations of our highly susceptible eastern white pine

had been established. From Europe it was introduced into eastern United States about 1900 and into western Canada about 1910, on infected nursery stock of eastern white pine. At that time forest tree nurseries were in their infancy here and could not produce the supply of seedlings needed for the forest tree planting program that had been initiated; hence eastern white pine seedlings were imported from Europe. Among these imported seedlings were some infected with blister rust; before the disease was recognized, they had been planted widely over reforestation areas in northeastern United States. Today blister rust of white pines is present in the East from the New England States west to Minnesota and Iowa, and south to North Carolina; in the West, from British Columbia east to Montana and Wyoming, and south to central California.

Prevention of Similar Introductions

After the introduction of white pine blister rust and the recognition of its seriousness, the Federal Plant Quarantine Act became law (in 1912) to protect our trees against future importations of foreign diseases. With the tremendous increase in international travel and transport of commodities of all kinds, it is logical to expect an increase in the danger of importing foreign pests; hence the necessity for a determined effort to prevent such occurrences. To that end, the United States Department of Agriculture is not only attempting to intercept all tree diseases before they arrive on our shores but is also attempting to catalogue and evaluate foreign tree diseases not now known to be in North America. The hope is that such information will allow us to take special measures to prevent the introduction of specific diseases. Here again, an ounce of prevention is worth a pound of cure.



Fire in a pine forest—a danger largely preventable but nearly as costly as diseases and insects



Courtesy of U. S. Dept. of Agriculture

Fifty-year-old stand of shortleaf pine breaking up from littleleaf in South Carolina

The Littleleaf Disease of Pine

How to prevent its ravages

George H. Hepting

IN the study of most of our serious forest tree diseases, the cause (usually a fungus) has been discovered fairly early. This has been the case with the chestnut blight, white pine blister rust, Dutch elm disease, and many others. The littleleaf disease has proved to be one of the most enigmatical problems ever to face those who study tree diseases. Its investigation has already required the full talents of the agronomist, physiologist, forester, entomologist, and horticulturist, as well as the pathologist, and the full story of the cause and factors affecting it is not yet known.

Symptoms

In 1934 and 1935, our attention was called to the dying of pole-sized shortleaf pines in Alabama. The disease was characterized by yellow stunted needles and very weak shoot and trunk growth. From two to ten years after these symptoms became evident, the trees died. The average time from the earliest appearance of symptoms to death of the tree is about seven years.

Seriousness

After observing the littleleaf disease in Alabama, foresters and pathologists scouted for it all over the South, and found it from central Virginia, in an arc through the Piedmont of the Middle

Atlantic States, curving westward through the north half of Georgia and extending through Alabama to the northeastern tip of Mississippi. Some littleleaf also occurs in east Tennessee. The principal pine affected is the shortleaf (*Pinus echinata*); but loblolly pine (*P. taeda*) is also subject to littleleaf in localities where the disease is severe on shortleaf pine.

In 1948, a typical year, timber worth five million dollars on the stump died of littleleaf throughout the South. Some of this timber was salvaged for pulpwood and lumber, but most of it was lost. This makes littleleaf rank along with fire as one of the worst enemies of the southern pines. Fortunately the immensely valuable longleaf and slash pines appear to be unaffected by the disease.

Cause

Early exploratory work turned up no ready answer as to the cause of littleleaf. One by one the team working on this problem investigated fertility levels, lack of some specific chemical element, soil moisture, climatic cycles, soil structure and organic matter, nematodes, fungi, insects, and other organisms on the roots and in other parts of the trees, as well as the possibility that littleleaf was a virus disease. We also studied the root-fungus complex known as mycorrhiza, through which the trees absorb food materials.

Each of these aspects required extensive experimentation involving isolation of fungi and inoculation with them, grafting of diseased and healthy trees to test for a transmissible virus, a long series of fertilizer trials to test for deficiencies, and a thorough study of soil properties under diseased and healthy stands.

The nutrition experiments disclosed that the symptoms of littleleaf are due primarily to failure to absorb nitrogen in sufficient quantity. The heavy addition of nitrogen fertilizers prevented littleleaf

and induced recovery in diseased trees. A special isolation technique, involving the placing of soil or roots from diseased trees in apples, showed that a well known water-loving fungus parasite, *Phytophthora cinnamomi*, was killing the fine absorbing roots of littleleaf trees. Soil studies showed that littleleaf was particularly severe on soils with poor internal drainage, and much less so on well drained soils. It was already known that the causal fungus thrived under wet conditions. Thus littleleaf appears to be a nitrogen deficiency of the tree and may be due to killing of roots by a fungus, particularly in the less well drained soils.

Benefits from Knowledge

Our current knowledge of littleleaf has enabled us to harvest millions of feet of timber that would otherwise have died and rotted. It has enabled private agencies such as pulp companies to avoid littleleaf timber in land purchases. It has led to a great reduction in the planting of shortleaf pine and the substitution of other species in littleleaf areas.

Possible Cure

A possible ultimate cure for littleleaf seems to lie in soil rehabilitation: building topsoil on our depleted Piedmont soils by keeping out fire, increasing the percentage of soil-building hardwoods, and preventing erosion; and by sound forest management. A good topsoil overlaid with a satisfactory humus layer may provide strong competition to the root parasite by other soil organisms harmless to the pines. It would also improve soil drainage and aeration, and provide better nutrition and better conditions in general for the growth of shortleaf pine.

Research is also being started to find the best substitute species for shortleaf pine on sites where littleleaf disease is found, and to determine if any shortleaf pines exist which can strongly resist this serious disease.

Birch Dieback

In ornamental and forest birches

J. R. Hansbrough

IN the past two decades yellow and paper birch in Maine and eastern Canada have been dying slowly but in enormous numbers. Trees of all ages have died, but the greatest mortality has occurred in trees of merchantable size for timber. In eastern Maine, New Brunswick, and western Nova Scotia losses in excess of 85 per cent of all mature birches have been reported. Users of birch wood within this area have had to convert to other woods, import birch from other regions, or move out. The economic and social effects are far-reaching. Fortunately, during the past two years there have been occasional reports of improvement in a few birch stands, which may indicate the gradual return of birch to normal health.

Symptoms

Trees die from the branch tips progressively downward. The first symptoms are sparse, yellowish, or dwarfed leaves, followed by dying of twigs, entire branches, and the whole tree. The accompanying figure shows a dying yellow birch tree, typical of the condition of birches over thousands of acres of forest land.

Possible Causes and Control

Some investigators have thought that birch dieback may be the result of unfavorable weather conditions, alone or in conjunction with the attacks of various insects and fungi. Research has so far failed to reveal the cause of the disease, and control recommendations are general rather than specific. Watering and feeding ornamental birch trees help to main-



Courtesy of U. S. Dept. of Agriculture

Dying yellow birch tree in Maine. Dead branch tips and sparse dwarfed leaves

tain their health. In forest stands, mature and overmature trees should be harvested, and cull trees should be cut, girdled, or poisoned. Cuttings should be either light enough to avoid drastic changes in the stand or else heavy enough to remove all birch and prepare the way for a new crop of young trees.

Gas Injury to Trees

Vigilance is the best protection

David H. Marsden

ILLUMINATING gas is poisonous to nearly all forms of vegetation when it reaches the root system. Injury to trees is particularly distressing because trees are difficult to treat and costly to replace.

Gas becomes a threat to trees only when it leaks into the soil from the underground piping system. A leak from a pipe is commonly near the root system of

a shrub, hedge, or tree. Plantings near the street are in greatest danger from leaking gas mains, but specimens well back on the lawn may be affected by a service pipe leak.

Kind of Gas

Natural gas is not highly poisonous to vegetation; it can injure trees, but usually only after long exposure. Those injuries which do occur are probably caused by oxygen displacement and drying of the soil more than by toxic prin-



Gas escaping from an underground main can be a seemingly mysterious killer

*Photo by Robert L. Coffin
Courtesy of the author*

ciples in the gas. Consequently the symptoms develop slowly and give sufficient warning to allow the leak to be repaired and treatment of the tree undertaken before irreparable damage is done.

Manufactured gas, on the other hand, can be quick death to a maple, an elm, a spruce, or whatever tree may happen to have its roots gassed. This gas contains not only a high percentage of carbon monoxide, so deadly to humans, but also significant amounts of other gases poisonous to plants. Scientists do not know what component is most toxic to plant life or exactly by what means the injury is produced. But whatever the mechanism of injury, the symptoms are what we see, and the treatment in the

light of present knowledge is of more interest here.

Symptoms of Injury

The most obvious symptoms of gas injury to trees appear in the leaves. Two degrees of leaf injury may be distinguished, depending on the concentration of gas in the soil. A chronic type of injury, produced by low concentrations, is manifested by small, light green leaves which can best be discerned from a distance, when the tree is contrasted with nearby healthy trees. Large leaks are more likely to produce either a pronounced mottling with white or yellow spots, or browning, curling, and death of the foliage. In the latter instance one or a few lateral branches may be



Rosy canker of London plane-tree, often associated with gas injury

*Courtesy of U. S. Dept.
of Agriculture*

affected first; then, as more of the root system is involved, the symptoms appear on a correspondingly greater part of the crown. In hardwoods, the affected leaves usually fall from the tree before the green pigment is entirely destroyed; in conifers, many of the needles die, turn orange-brown, and remain on the tree until they are shaken loose by the wind.

If a tree is not killed quickly, other symptoms develop. These include dead buds (which may be the only noticeable symptom during the dormant season), dieback of the leader and laterals, loosening of the bark of the trunk and larger branches, and formation of spongy, cankerous tissue on the lower trunk. Affected roots usually die back from the tips. Gas-injured trees are quickly invaded by borers and fungi, and hence deteriorate rapidly.

The symptoms of gas injury are closely akin to those of root injury from other causes. For that reason, in the diagnosis of a tree showing these symptoms, one must consider the possible implication of drought, excessive moisture, change of grade, nutritional deficiencies, root rots, and the common wilt diseases of certain trees.

Ultimately the convincing evidence of gas injury is the presence of gas within the root area of the tree. The presence of gas may be suspected if grass, weeds, or other small plants are unaccountably sick or absent in a semicircular or circular area, and a gas pipe is known to be close by. A simple way of checking for gas is driving bar holes 12 to 18 inches deep within the suspected area and sniffing these immediately. A more positive confirmation can be had by drilling through the pavement over the main and testing with a combustible gas indicator. Most gas companies have this instrument and can be called upon to make such tests.

Treatment

Unfortunately the treatment of gas-injured trees is often unsuccessful. Death of the tree may ensue even when remedial measures are undertaken as soon as the first symptoms of injury appear. The success of the treatment depends on the amount of gas to which the roots have been exposed, the site, and the tree; and there is no way to predict how a particular tree will respond. Standard treatment consists of the following steps, which are best performed by a tree expert company using special equipment.

1. Stop the leaks (a job for the gas company).

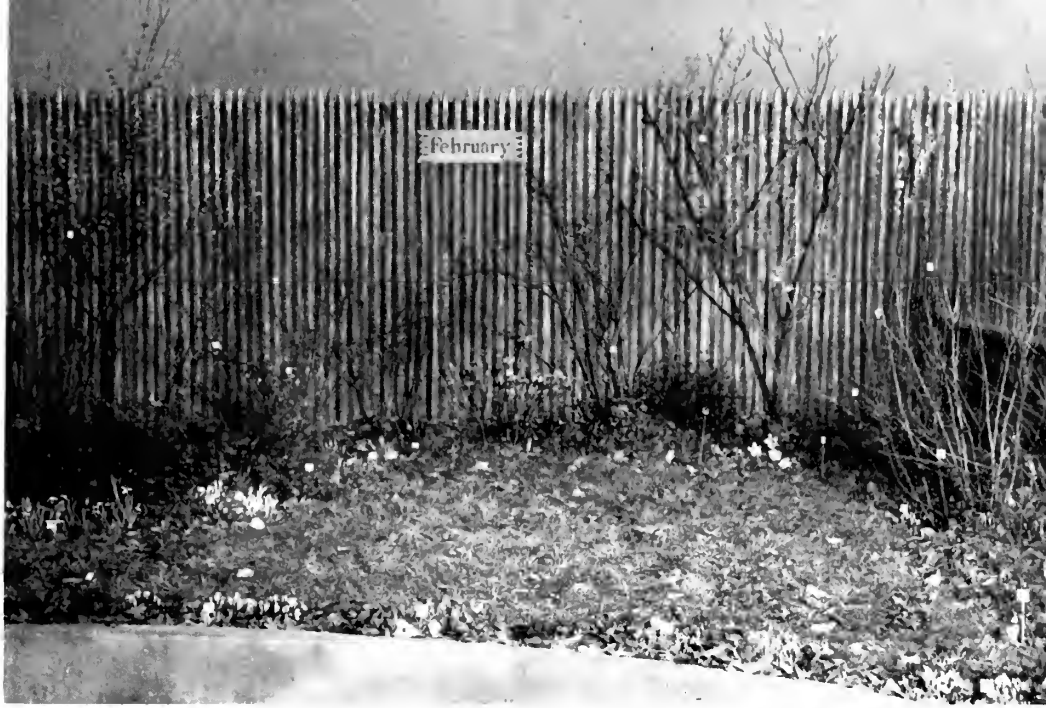
2. Aerate the soil by leaving repair holes open; by trenching between the leak and nearby trees; or by drilling holes and displacing the gas from the soil with an air compressor. If a replacement tree is to be planted, it is most important that the soil be thoroughly aerated or replaced.

3. Apply a moderate amount of an inorganic fertilizer under the surface of the soil, to stimulate the growth of new roots.

4. Wash the soil with large quantities of water to leach out or displace residual gas and to dissolve and spread the fertilizer. The water should be run into dug or drilled holes until the ground is saturated to overflowing. Special pressure equipment gives best results in this.

Also, the tree should be pruned, to remove all dead and dying branches which might serve as entrance points for insect and fungus pests.

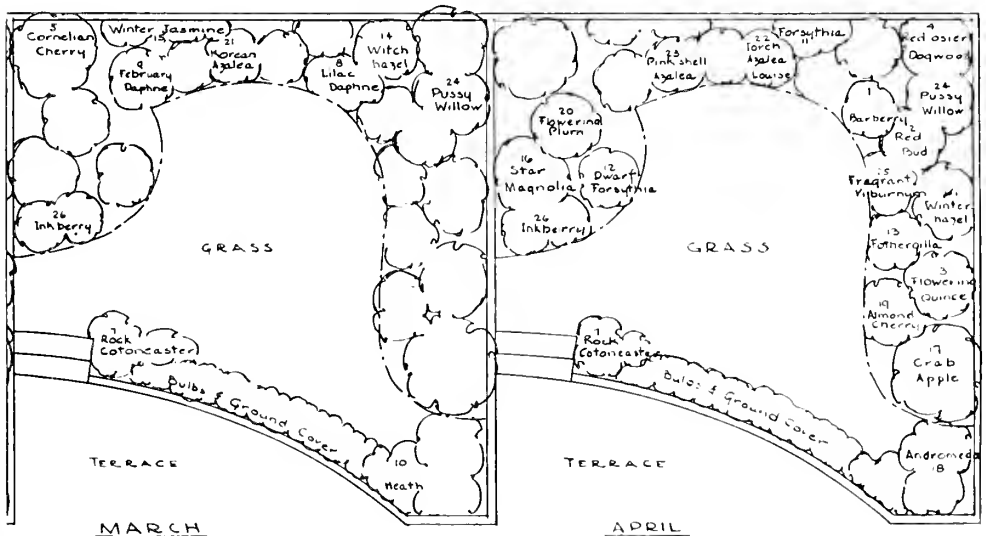
In conclusion, it is emphasized that vigilance is the best protection against gas injury. Most gas leaks can be detected by their effects on grass and other small vegetation before any symptoms appear on woody perennials. Learning to look for and recognize these warnings may save valuable trees.

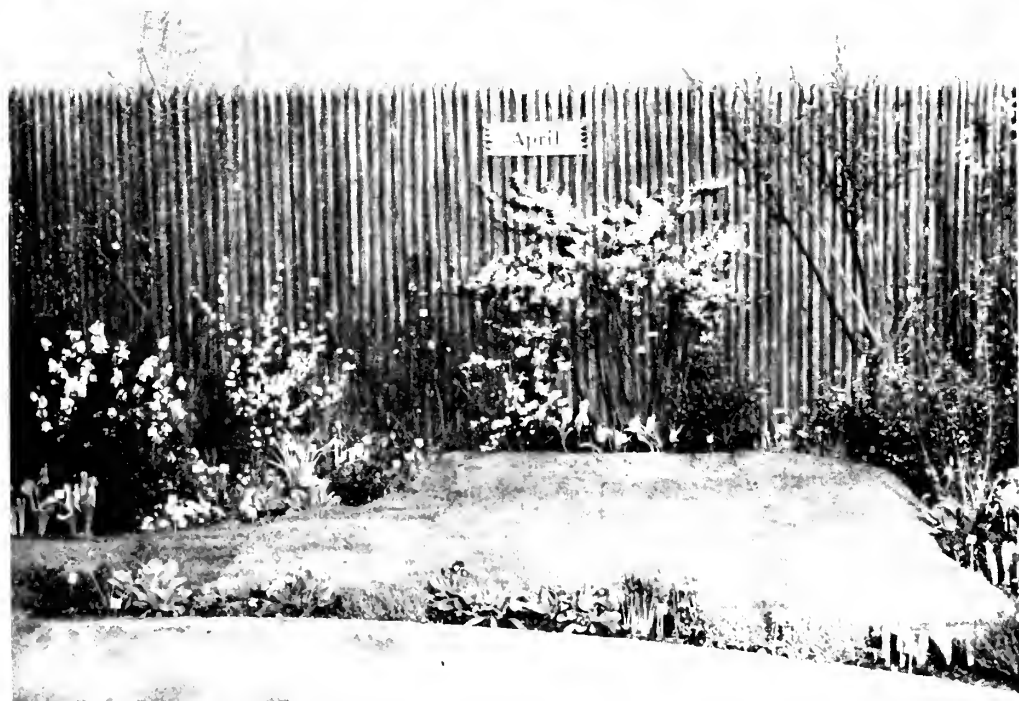
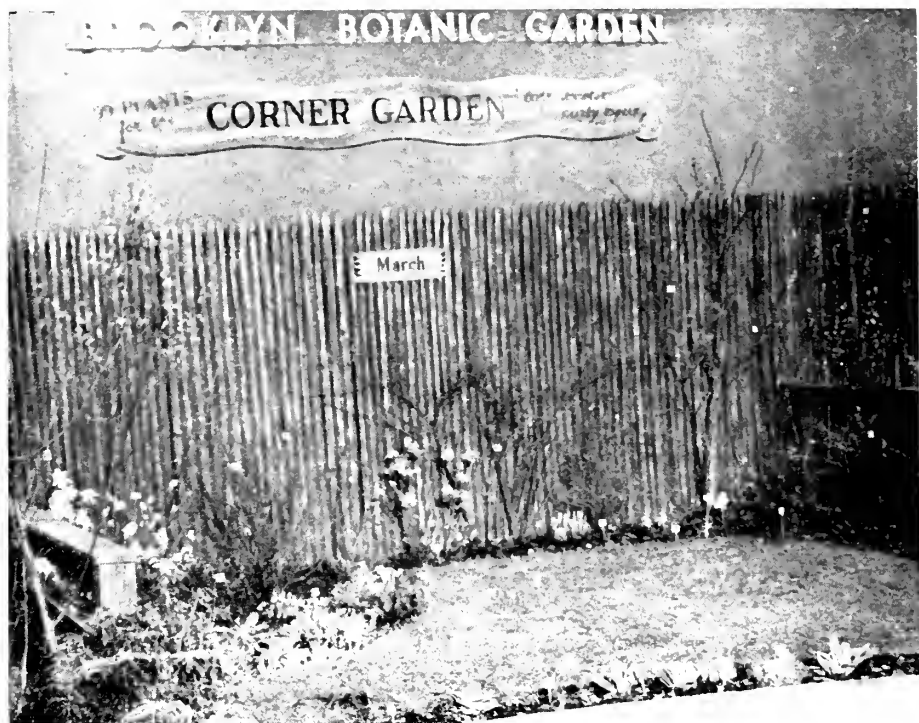


Within the Brooklyn Botanic Garden

"Ninety-nine Plants for the Corner Garden in Late Winter and Early Spring" was the theme of the Botanic Garden's exhibit at the International Flower Show in New York, March 5 to 10, 1951. The same garden was shown as it would look in February, in March, and in April, with grass, ground covers,

bulbs, and flowering shrubs in appropriate stages of development. The accompanying photographs and plans show the general appearance and some of the plants used. The full list of plants is available upon request. The exhibit was awarded the Gold Medal of the Horticultural Society of New York.





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To reach the Garden:

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BY AUTOMOBILE:

From Long Island, take Eastern Parkway westward, and turn left at Washington Avenue.

From Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway; follow the Parkway to Washington Avenue, then turn right.

PLANTS & GARDENS

AUTUMN
1951

Fruits
for the
Home Garden

How to Select
and Grow Them
for Beauty
and for Utility

NEW SERIES

VOL. 7

NO. 3



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PLANTS & GARDENS

Toringo Crab Apple (*Malus sieboldi arborescens*)

VOL. 7

Autumn, 1951

No. 3

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Except where otherwise credited, drawings by NATALIE HARLAN DAVIS, photographs by LOUIS BUEHL

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Richard Averill Smith

Bright fruits of the apple tree in autumn—as ornamental as the pink and white blossoms of spring

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES
BROOKLYN BOTANIC GARDEN
1000 WASHINGTON AVENUE
BROOKLYN 25, NEW YORK
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Autumn 1951

In this issue of PLANTS & GARDENS Guest Editor Slate and his corps of experts in the fruit-culture field show how one can have a garden that combines beauty with utility. To many this will be an old story, but — fine fruit does not grow merely for the asking, and this handy reference book will provide an opportunity to review fruit-growing practices and to learn something of new varieties and methods.

Origin of common fruits. Temperate America has given the world the strawberry, blueberry, blackberry, black raspberry, and some of the grapes and plums. But many of our cherished fruits have come from other continents: from southeastern Europe and southwest Asia came the apple, pear, sweet and sour cherries, and the Old World grape; and from Asia, peach, apricot, and certain of the plums.

Fruit-producing plant families. All the World's 150,000 kinds of flowering plants belong in approximately 300 different families. Interesting it is that only two of these provide any considerable number of fruits for the enjoyment and dietary needs of civilized man. In the temperate parts of the world the Rose Family has some twenty different fruits to its credit. In the tropical Rue Family (p.218) the genus Citrus is best known, and there are numerous varieties of citrus fruits. Other plant families, except Walnut, have only one or two kinds that are useful to man.

Far North. The northernmost horticultural station with which we are in contact, and perhaps the most northern in the world, is at Ujebyn, in Arctic Sweden near the Baltic Sea. Ujebyn is only a few miles from Lulea — which can be found on almost any map. Here, about 60 miles south of the Arctic Circle, some interesting experiments are going on, testing the hardiest fruits (p.180).

Fruits vs. ornamentals. Back-yard fruit culture is not quite so simple as growing ornamentals. The latter may be attacked by fungus diseases or insects, but these rarely show up more than a part of the season and may never greatly harm appearances for the casual observer. The same holds for the plants on which fruit grows. But the fruit itself is the measuring stick for evaluating the season's efforts, and an infestation of almost anything, however brief, may damage the quality of the harvest. So, although borers and leaf miners may not greatly affect the aesthetic qualities of dogwood or holly, a worm in an apple never fails to disappoint the consumer — whether discovered in time or not.

If home fruit growing is to be a new venture, it is well to start with kinds that do not require much special attention: strawberries, bramble fruits, blueberries, and grapes are examples.

In spite of new problems that fruit growing may bring, why not combine landscape beauty with the bounty of the harvest? Fall is definitely the time to order, and for many things the time to plant.

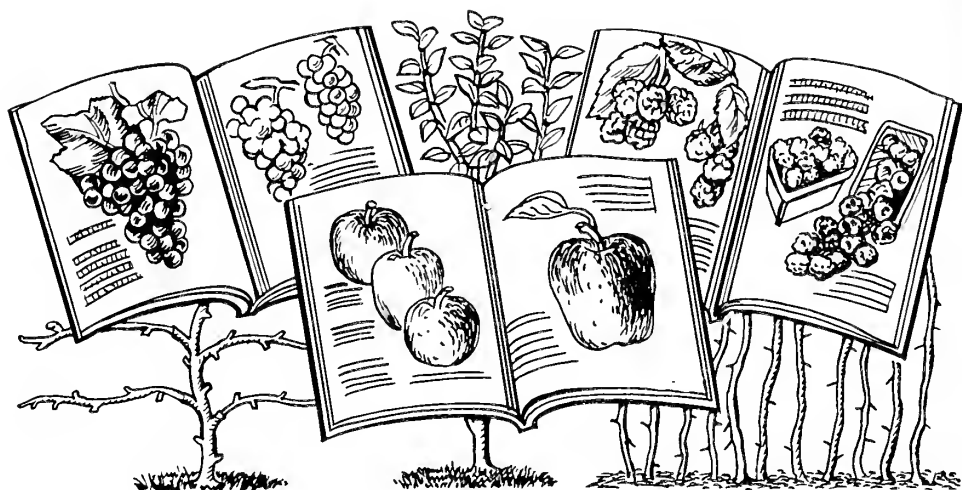
Whatever you grow and wherever you grow it, give it your enthusiasm and affection.

Sincerely,



Director

P. S. If you did not receive the summer issue, please write us at once.



PLANNING FOR THE HOME FRUIT GARDEN

How to choose and start the plants

George L. Slate

THE home fruit garden is a very pleasant thing to think about, but its realization involves much work and mental effort before the fruits described in the catalogues in mouth-watering terms are finally produced on one's own plants. The pitfalls are numerous and the disappointments many, but the rewards are great for those who will do what is necessary to produce high-quality fruit.

The reward is an abundance of delicious plant-ripened high-quality fruit—in texture, flavor, and color not available on the market—extending throughout the year from the first strawberry to the last apple. Fruit is an important item in the diet, used fresh or made into the many culinary preparations known to every good housewife. Children like nothing better than picking and eating fruit directly from the plants.

Choice of Kinds

The great amateur fruit collections of the past are no longer grown. The experiment stations have replaced the amateurs. Fruit growing is still a pleasant hobby; and for those who wish to pursue the matter further, **grapes** are suggested. In color, texture, and flavor they are available in far greater variety than the uninitiated can imagine. A collection of grapes can yield as much pleasure as a collection of flowers.

The **small fruits** are first choice for the small home garden, as they require no expensive equipment and are suited to small areas. They bear at an early age, are troubled much less than tree fruits by insects and diseases, and (in the various kinds and varieties) may provide fruit from early June until frost.

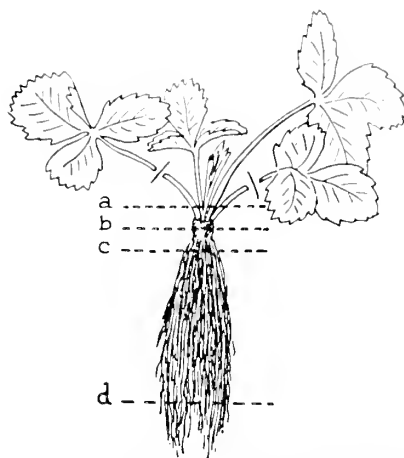
The **tree fruits** require much more space and must be sprayed if usable fruit is to be produced. Unless one is prepared to spray, it is not worth while to grow tree fruits. Late-ripening

apples which must be stored for winter should not be grown unless a fruit cellar is available.

Site and Stock

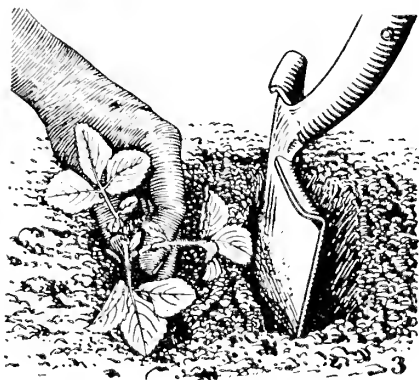
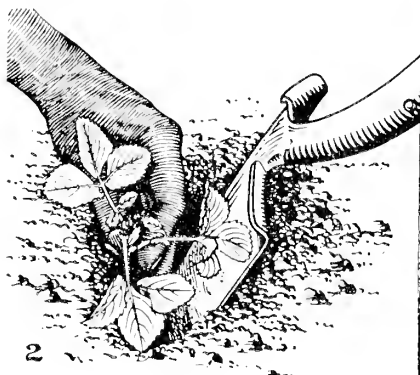
A good site is essential to success; it must be beyond the roots and shade of large trees. Good air circulation favors rapid drying of the foliage and brings less trouble from fungus diseases. Known frost pockets (as low spots where cold air settles are called) should be avoided, as the frost will ruin many crops. Perennial weeds, particularly quack (witch) grass, should be destroyed before the fruits are planted, as it is impossible to clear them out of a berry planting.

Nursery stock should be ordered from firms specializing in fruit trees rather



Courtesy Cornell Extension Service

Strawberry plant, showing where to trim leaves and roots (d), and depth of planting: planted too deep if soil is up to level a; b, correct depth; c, too shallow



Courtesy Canada Dept. Agriculture

How to set a strawberry plant: (1) open hole with spade; (2) set plant behind spade; (3) push soil against roots; (4) firm soil around plant

than from general nurseries that do not grow their own stock. There are specialists in tree fruits, grapes, strawberries, blueberries, and nut trees; and these are the best sources of planting stock. Plants purchased near by, if freshly dug, should arrive in better condition than plants shipped a longer distance. The larger sizes of 1- or 2-year-old apple, pear, plum, and sour cherry are preferred. With the peach, sweet cherry, grape, and small fruits the 1-year-old plants should be used. Older plants, especially the so-called bearing-age trees, grapes, and berries, should not be planted. They experience too much shock in moving and are slow to establish, and the little fruit that may be produced the first year is at the expense of growth that will fruit later.

Setting Out

Time. The plants may be set either in the fall or in the early spring. Peaches are more safely set in the spring; and strawberries are usually set then, although fall planting is practicable. The

fall planter gets freshly dug trees that have not spent the winter in a nursery cellar, and is more likely to get the desired varieties.

Care before setting out. When the shipment of plants arrives, it should be opened at once; and if planting is not done immediately, the plants should be heeled in, in a shallow trench; they should be spread out and the roots covered with moist soil. If the plants appear to be dry they should be soaked in water for several hours before being planted or heeled in.

Method. A properly set plant is as deep as it grew in the nursery (or slightly deeper) and has the soil so firmly packed about the roots that there are no air holes and the plant will withstand a strong tug without becoming loosened in the soil. To set the tree fruits, the hole is dug large enough to hold the roots in their natural position without crowding. The tree is set in the hole in such a way that the trunk is vertical. As the soil is filled in, it is worked in around the roots and packed firmly with the feet. If the ground is



Bundle of raspberry plants as received from nursery



U.S. Dept. Agriculture

Raspberry plants from the nursery, heeled in until planting time

dry, as it is likely to be in late spring, a pailful of water should be poured into the hole. On heavy soils it is an advantage to mix a pailful of wet peat moss with the soil.

Strawberry plants are set behind the spade or trowel; the tool is inserted vertically into the soil and pulled forward to make an opening into which the roots of the plant are thrust and spread out in a fan-shaped manner. After the tool is withdrawn, the soil beside the plant is stepped on to firm it against the roots. The crown of the plant should be at ground level (p. 165).

Pruning and Thinning

The **tree fruits** and **grapes** should be pruned at planting time, according to instructions in the articles on pruning these fruits (pages 210 and 193).

The **brambles**, **currants**, and **gooseberries** are cut back to about 8 inches at planting time. The blossoms which soon appear on the newly set strawberry plants should be removed to prevent fruiting the first year.

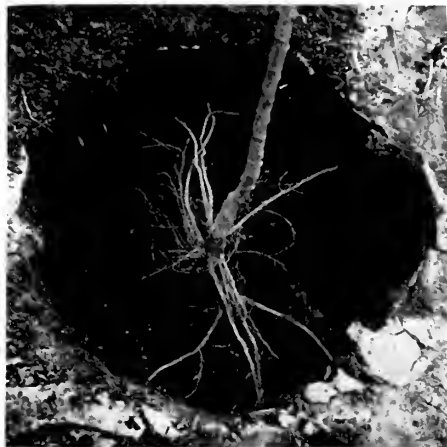
The **tree fruits** often bear far more fruits than they should. This overloading results in small fruit of poor color and quality, and delayed maturity. Over-

loading may also cause severe damage to the tree by breakage of the limbs. To prevent these disadvantages, the fruits should be thinned as soon as it appears that a heavy crop is set.

Apples are thinned in late June or early July to a spacing of 6 or 8 inches, **peaches** to 6 inches, and **plums** about 3 or 4 inches. In thinning, the smaller fruits and those with insect or disease injuries are removed, and only the better specimens are left.

Planting Distances

	Feet between rows	Feet between plants
Apple (standard)	40	40
Pear (standard)	30	25
Peach	20	20
Plum	20	20
Cherry, sour	20	20
Cherry, sweet	30	30
Grape	8	8
Raspberry	8	3
Blackberry	8	3
Blueberry	10	8
Currant	8	5
Gooseberry	8	5
Strawberry (matted row)	3½	1½



Courtesy Ohio Agricultural Extension Service
Young fruit tree set in hole large enough to allow spreading out of roots



U.S. Dept. Agriculture
Packing the soil as it is filled in around the roots

A HOME FRUIT GARDEN

Planned for efficiency and beauty

Philip L. Robinson

A GARDEN of fruit can be a source of great satisfaction and pleasure. Freshly picked fruit is a delight to the epicure, and home-raised fruit is a relief to the food budget. Flowering trees and bushes in one's own garden are a gratifying sight, and the blossoms and fruit give off a pleasing aroma.

The pleasure and utility derived from the garden will be much enhanced if the design and arrangement of the integral parts be worked out with an eye for efficiency. Ease of caring for the plants and harvesting the crop is of paramount importance. So also are the proper location and spacing of the plants to insure that each specimen receives the optimum of sunlight, air, and nutriment.

When efficiency combines with the basic principles of design to create a pleasing setting for the out-of-doors activities of the family group, then the time involved in planning is well spent.

The garden in the accompanying illustration was developed in an attempt to combine efficiency of fruit production and upkeep with gracious living. Let us analyze the plan and see how it was accomplished.

General Plan

In the first place the garden is formal, that is, it has a definite form or shape. Experience has taught that a formal garden is easier to care for than one that is informal. Edges of beds are straight, for the most part. Plants are adjacent to foot paths, making picking, spraying, and cultivating easy.

We start with a small house and one-car garage located in conventional positions on a lot 60 feet wide. The land slopes gently away from the house toward the north or rear.

A paved terrace of sufficient size to accommodate a half-dozen chairs and a small table lies in the shadow of the house. One end of the living room or the dining room overlooks the garden. The kitchen is handy for serving tea or iced drinks.

Plants

During the late afternoon the shade of the house moves away from the terrace as the sun swings toward the west. A spreading **cherry tree** (A) casts a welcome shadow on the terrace. It must be high-branched for walking under and a sour variety for self-pollination.

A combination **grape arbor** and trellis extends the east side of the garage toward the house. The arbor throws a bit of shade on the driveway, while the trellis screens the expanse of glaring pavement from the terrace.

Wire fences on the property lines at sides and rear do double duty as protectors and as supports for more grapes (G) and for **raspberries** (L). The actual proportions of each can be varied at will.

The three beds border an expanse of lawn which can be used for games such as croquet. A seat or bench opposite the terrace adds a note of serenity to the picture as well as being of considerable utilitarian value.

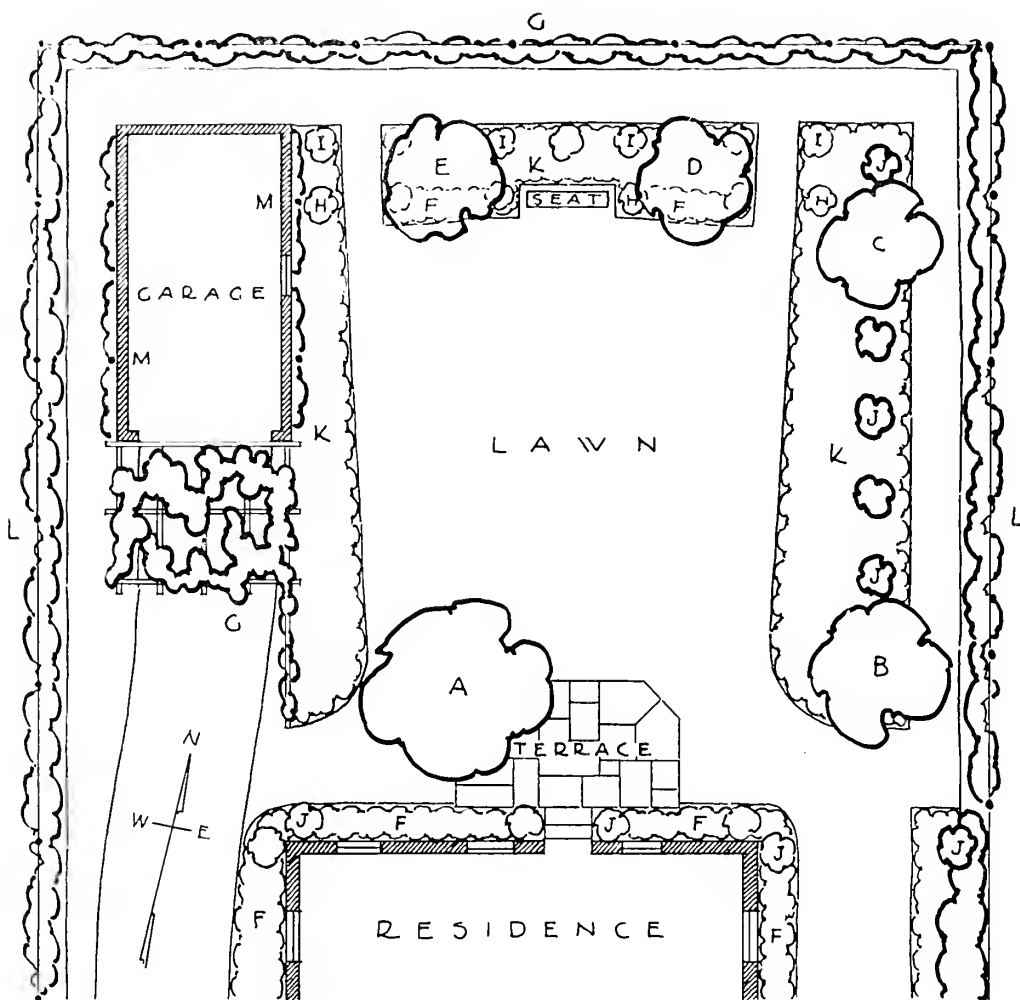
A **dwarf apple tree** (B) and a **pear** (C) accent the right-hand side of the garden. A **peach** (D) and a **plum** (E) flank the seat and tend to terminate the view from the terrace. The trees are well spaced for their own good and to allow room for adjacent plants.

For purposes of making pollination of the apple and pear trees certain, and because they are productive and decorative in their own right, **espalier apple** and **pear** trees are trained on trellises against the east side of the garage. They should be varieties compatible with those of the

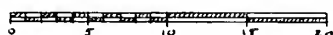
standard trees. An apricot and a nectarine might be trained on the other wall of the garage.

The modern garden would be incomplete without its **blueberries**. Because they are decorative at all times, and

especially so in the autumn when the foliage rivals the reds of the oaks and sugar maples, they have been used as accent plants (J) in the foundation planting. Others form a row joining the apple and pear trees.



A HOME FRUIT GARDEN



A=MONTMORENCY CHERRY TREE B=MCINTOSH APPLE TREE C= BARTLETT PEAR TREE (DWARF) D= PEACH TREE E= PLUM TREE F= FLOWERS G=GRAPES H= CURRANTS I=DWARF PEAR TREES J=BLUEBER-
RIES K= STRAWBERRIES L= RASPBERRIES M= ESPALIER APPLE
PEAR, APRICOT AND NECTARINE TREES

Author courtesy



Blueberry bush
in bloom

McFarland

A double row of **currant bushes** (H) and **gooseberries** (I) helps to frame the rear of the garden and to form a backdrop for the seat. Their proximity to walks and lawn makes picking easy.

Strawberries are found in the beds (K) in quantities to delight the deep-freeze enthusiast. Being in three separate beds, their proper rotation should not be difficult.

Lastly, for the sake of sheer beauty we tuck in **flowers** wherever feasible. Some are shown in combination with the blueberries along the house walls. Others edge the rear bed at each side of the seat. Experience will indicate other places where they can be used to advantage. Annuals are valuable for replacements when and where more permanent sorts may fail.

While this garden has been designed

for the relatively small place and for the conventional architecture, it may easily be adapted to the larger place and to other styles of architecture. The so-called ranch house affords many opportunities for the use of fruits, especially the tree forms.

Twenty years ago an architect designed four houses for a speculative builder on the four corners of a street intersection. One was English, one French Provincial, one Mediterranean, and one Colonial. Each had its orchard, its grapes, its strawberries, its blueberry and currant bushes. These houses sold quickly to prospects from the city who yearned for a place in the country (suburban Long Island). To them the orchard and berries spelled country living: their own fruit on the breakfast table, an apple by a log fire in the winter, jelly at all times from their own plants.

Everbearing red
raspberry SEP-
TEMBER: fall
crop



Courtesy N. Y. Agricultural Experiment Station

FRUIT VARIETIES

*Suggestions for the home garden
in the Northeast*

Ernest G. Christ

THE selection of varieties for the home fruit planting is extremely important and determines to a great extent the future success of the planting. Choosing the proper varieties can be difficult at times, because new introductions are constantly being added to the long list of fruit varieties.

One should select varieties on the basis of several qualities. A good fruit variety should be productive, winter hardy, and quite resistant to the commonest diseases. It should be of fair

to good eating quality. It need not be the largest, the most attractive, and the best in dessert quality, because in many instances the most desirable characteristics are combined with highly undesirable traits such as susceptibility to disease or to winterkilling. One should give some thought to pollination, also, when selecting varieties.

Fruits may be divided into two main groups: the small fruits, including the berries and the grapes, and the tree fruits. Variety recommendations differ for the different areas of the country. The varieties mentioned in the following discussion are mainly for the Northeast, although many are adapted to a much wider range.



Elsie M. Kittredge

Gooseberries

SMALL FRUITS

Strawberries

June-bearing varieties include the following:

MIDLAND, earliest-ripening, large medium-dark, good dessert quality. Does not produce runners freely.

PREMIER, early-ripening, medium to large, very productive, and of fair dessert quality.

FAIRFAX, early midseason, large, dark red, excellent dessert quality. Plants vigorous and large.

CATSKILL, midseason, large, bright red, attractive berry of good dessert quality. A productive variety.

SPARKLE, late midseason, medium size, bright to dark red, and of good dessert quality. One of the best for freezing. Productive and resistant to red stele root disease.

TEMPLE, much like **SPARKLE**. Resistant to red stele root disease and a very vigorous grower.

FAIRPEAKE, late-ripening, large, dark red berry resembling **FAIRFAX** in appearance and dessert quality. Does not make many runners and is medium-productive.

Everbearing varieties. **MASTODON**, **GEM**, and **WATZATA** are three older recommended varieties that have proved to be productive. Two recent introductions are

SUPERFECTION and **RED RICH**; these are reported as excellent varieties.

Red Raspberries

LATHAM, a dependable, late-ripening variety of fair to good dessert quality. A hardy and most reliable berry.

NEWBURGH, a large and very firm berry of good dessert quality. Also hardy and reliable.

TAYLOR, largest of those mentioned and of the best dessert quality. Not so hardy as **LATHAM** and **NEWBURGH**; recommended for northern New Jersey and north.

MILTON, also large berries, resembling **TAYLOR** and recommended for the same area. Resistant to mosaic disease.

SEPTEMBER, the best everbearing raspberry, ripening its fall crop before frost. The dessert quality of the fruit is good. It produces a good spring crop (P. 171).

Black and Purple Raspberries

Black and purple raspberries are susceptible to the virus disease, mosaic. To lessen the danger of infection, they should be planted no closer than 200 yards to the red varieties or wild red raspberries.

Black. **BRISTOL**, **CUMBERLAND**, **LOGAN**, and **DUNDEE** are good varieties. **LOGAN** ripens first, and the berries are smaller in size than the other varieties. **BRISTOL** and **DUNDEE** ripen after **LOGAN** and ahead of **CUMBERLAND**. All four varieties overlap in ripening time; the harvest season can be extended by planting more than one.

Purple. **SODUS** and **MARION** are the best purple raspberry varieties. **SODUS** ripens first. **MARION** may be planted in addition, to extend the ripening season. Both varieties are hardy, vigorous, and productive.

Blackberries

ELDORADO is the best variety for the home garden. The berries are fairly large, glossy, and of good dessert quality. The plant is vigorous and productive. **ALFRED** is another good variety but is more susceptible to orange rust.

Currants and Gooseberries

Currants. RED LAKE and PERFECTION are two good red currants. PERFECTION ripens first, with large clusters of fairly large berries of good dessert quality. RED LAKE ripens midseason to late and produces large fruits on large clusters; it is the most widely grown red currant. [It is illustrated in the color section.]

Gooseberries. POORMAN is the best red-fruited variety, ripening late. The fruit is medium to large in size and the bush is vigorous and large-growing. CHAUTAUQUA and DOWNING are two recommended green-fruited types. CHAUTAUQUA produces large fruit, and DOWNING medium-size fruit. Both are vigorous and productive.

Blueberries

Blueberries are more exacting in their soil requirements than most other fruit crops. They do best in an organic type of soil that is acid.

WEYMOUTH, an early-ripening variety, to start the season. Fruit above medium in size, dark blue, firm, and of fair quality.

STANLEY, one of the older varieties, ripening in midseason. The bush is erect, vigorous, and productive. The berries are medium to large and of good quality.

ATLANTIC, one of the newer midseason to late-ripening varieties. A vigorous spreading bush, very productive. The berry is large, of good blue color, and medium in quality. Excellent as a frozen product.

JERSEY, one of the older late-ripening varieties, with a productive bush average in size. The berries are large, of good blue color, and good in quality.

BURLINGTON, a new late-ripening variety; vigorous, upright, spreading bush. The berries are medium in size, of good color, and medium in quality.

Grapes

SENECA, a yellow grape of good quality, ripening very early. The clusters and berries are medium in size and hang to the vine well.



McFarland

BURBANK plums

FREDONIA, an early-ripening blue-black grape of fair quality; medium-size cluster with medium to large berries. An excellent red-juice grape, also good for table use. The vine is a vigorous grower and its yield relatively heavy.

DELAWARE, a red variety ripening in midseason. Considered the standard for quality as a table grape. Yields are relatively light as a result of the small plant, small clusters, and small berries.

NIAGARA, the most popular white grape. On sandy open soils, it develops a golden-yellow color. Ripens in midseason. Vigorous and productive, with large clusters.

CONCORD, a blue-black grape of fair quality, ripening in midseason. The clusters are medium in size, as are the berries. The most widely grown variety in the East for juice and for table use.

CATAWBA, a late-ripening red variety of good dessert quality. Requires a long growing season for maximum quality. Relatively susceptible to fungus diseases.

SHERIDAN, a late blue-black grape of very good quality. Berries and clusters large. Ripens a week or ten days after CONCORD. Needs rather heavy pruning and fertile soil. Requires a long growing season and is not recommended for the more northern areas.

STEUBEN, a new late-midseason black grape ripening with CONCORD. Clusters somewhat resemble SHERIDAN. A promising late variety for areas where SHERIDAN will not ripen completely.



GOLDEN DELICIOUS apples

McFarland

TREE FRUITS

Apples

Early summer. Two good varieties are LODI and MELBA. LODI is a large, yellowish-green apple for cooking. The tree is small to medium and tends to bear annually. MELBA is bright red, medium in size, and excellent for eating fresh. Medium-size tree, bearing biennially.

September to frost. The following varieties are in the order of ripening.

CORTLAND, large red apple covered with a purplish bloom. The flesh is fine-textured; this variety is excellent for eating fresh or cooked. The tree is medium in size and bears annually.

JONATHAN, medium-size, bright red, and excellent for eating fresh or cooked; especially good for sauce. The tree is medium in size, comes into bearing early, and tends to bear annually.

GOLDEN DELICIOUS, medium-size yellow apple with crisp flesh and good flavor, excellent for eating fresh. The fruits must be thinned to attain good size. The tree is medium-size and bears biennially.

ROME BEAUTY, large, red, late-ripening apple best suited for cooking or baking. Medium-size tree, bearing annually.

Red Sports or Strains. Many of the standard apple varieties have produced so-called red sports (or mutations). These sports resemble the parent variety, and in most cases are practically identical except that the fruits are more completely and highly colored. The names of these sports resemble the parent name in many respects. For example, a red sport of JONATHAN is called JONARED. In some instances the parent variety name is prefixed by the word "red," as in RED ROME. The red sport varieties may be planted in place of the parent variety where more red color is desired.

Crab Apples

DOLGO, a small bright red apple of good quality for culinary uses; excellent for jelly and juice. The tree is medium in size, and yields heavily. It is very attractive at harvest time [illustrated in the color section].

HYSLOP, a large brilliant red apple

ripening after **DOLGO**; excellent for jellies. The tree is small and very hardy and is a good producer.

Pears

TYSON, an early-ripening small-size pear of good quality. The skin is slightly russeted. The tree is large and resistant to fire blight.

WORDEN SECKEL, a small russet-colored pear with a bright red-blushed cheek; very juicy and mildly sweet in flavor. Resistant to fire blight.

SECKEL, a small, very sweet, and aromatic russet-colored pear. Excellent fresh, spiced, or pickled. The tree is large and resistant to fire blight. An old popular variety [illustrated in color].

BOSC, a late pear of excellent quality; keeps well. A large pear, distinguished by its long neck and yellow skin covered with russet. [Illustrated in color.] The tree is susceptible to fire blight.

Peaches

JERSEYLAND, large, firm, attractive, yellow-fleshed freestone, ripening early. Colors well and hangs to the tree very well.

RARITAN ROSE, a medium-size, attractive, highly colored, white-fleshed freestone of excellent quality.

TRIOGEM, a firm, yellow-fleshed, highly colored freestone. The fruits ripen slowly, are of medium size, and hang to the tree well. Excellent for canning and freezing.

SUNHIGH, a large, firm, yellow-fleshed peach which ripens slowly and hangs to the tree. Develops good red color. Excellent for canning and freezing.

ELBERTA, large yellow-fleshed peach with a yellow under-color mottled with red. Of good quality when tree-ripened; good for canning and slicing. The most widely planted peach variety.

Cherries

MONTMORENCY, the most popular and important **sour** cherry grown. The fruits are large, of good dessert quality, and excellent for pies. [Illustrated in color.] The tree is medium in size and very productive.

Sweet cherries include the following:

BLACK TARTARIAN, an early-ripening purplish-black sweet cherry of good quality. The flesh is soft and purplish red in color. The tree is vigorous and large.

YELLOW SPANISH, an orange-yellow sweet cherry with a red or pink blush. The flesh is firm and of good quality. The tree is very large and productive and comes into bearing young.

WINDSOR, a dark red medium-size sweet cherry. The flesh is firm and of good quality. The tree is hardy, tall, and upright and comes into bearing late.

SCHMIDT, a large red sweet cherry. The flesh is rich red, firm, and of good quality. The tree is large, vigorous, and productive.

Plums

STANLEY, a large prune-shape dark blue plum of good quality, excellent as fresh or canned fruit. The flesh is greenish yellow and quite free from the pit. The tree is vigorous, usually comes into bearing early, and produces annually.

ITALIAN PRUNE, an old variety. Blue-black oval plum of good quality, excellent for canning and as fresh fruit. The flesh is yellowish green and is free from the stone when ripe. The tree is smaller than **STANLEY** and usually comes into bearing later.

METHLEY, an early-ripening good-quality purplish-red plum, best suited for eating fresh. The flesh is soft and red and clings to the pit until the fruit is thoroughly matured. The flesh is slightly bitter around the pit until thoroughly ripe. The tree yields heavily, and the fruit must be thinned to attain good size.

ABUNDANCE, a red plum of medium size with yellow flesh; of good quality, but a poor-keeping plum. It is susceptible to brown rot and drops freely when fully ripe. The tree is vigorous and produces annually.

BURBANK, perhaps the main Japanese plum in the East. The fruit is red, large, and of good quality. Used for jam or for eating fresh. Requires thinning for good-size fruit. (Picture on page 173.)



Courtesy N. Y. Agricultural Experiment Station

RHODE ISLAND GREENING apple on the dwarfing stock EAST MALLING IX

DWARF FRUIT TREES

*How they are made and
how they should be grown*

Karl D. Brase

Varieties of tree fruits are not propagated from seed but are multiplied by **grafting** the desired variety on a closely related plant, the root stock. The fruit tree, then, consists of two parts: the variety, which makes up the trunk and branches, and the root stock, which supplies the root system. Small seedling trees raised from the seeds of certain apple, pear, peach, plum, and cherry varieties are used as the root stocks. Trees on seedling root stocks grow vigorously and require much space; they are not suitable where space is limited or where insect and disease control must be done with hand sprayers.

Dwarfing Stocks

To make possible the culture of tree fruits in gardens, dwarfing root stocks

have been developed to control tree size. These root stocks restrict vegetative growth of the variety and bring the tree into bearing at a much earlier age. By the use of the correct size-controlling root stock, all of our well known apple varieties and many pear varieties may be grown as so-called *dwarf* trees. Peach, plum, and cherry trees, also, can be dwarfed to a certain extent if grown on compatible dwarfing root stocks.

What root stocks are used to dwarf a tree? They are not such seedlings as are used for standard trees but are selected types of seedlings that have shown dwarfing habits. These selected types are propagated vegetatively by layering, by hardwood cuttings, or by root cuttings. Each plant propagated from a selected type or clone is identical with every other plant of that type.

Apple. The best-known and now widely used size-controlling apple root stocks are some of the EAST MALLING (E.M.)



Courtesy N. Y. Agr. Exp. Station

GRIMES GOLDEN apple on E. M. IX

root stocks; for instance, E.M. IX for a typical dwarf or miniature apple tree, and E.M. VII for apple trees of so-called *semidwarf* size.

Pear trees are dwarfed by growing on a quince root stock. Recommended stocks are **ANGERS** quince type A and common quince types B and C. The last-named type gives the greatest growth restriction, whereas **ANGERS** quince Type A has been found the best all-round dwarfing root stock for many pear varieties.

Peach, plum, and cherry. The western sand cherry (*Prunus besseyi*), used as the root stock for peach and plum trees, rather severely restricts tree size. The Mahaleb and certain Morello cherry varieties, when used as stocks for cherries, dwarf them less than the other stocks mentioned. Peaches, also, can be dwarfed, by growing on apricot and Manchuk, or Nanking, cherry (*Prunus tomentosa*) root stocks.

The root stock is as important as the variety itself. It is advisable when ordering dwarf trees to specify the root stock as well as the variety; for instance,

the apple **GOLDEN DELICIOUS**/E.M. IX, or **GOLDEN DELICIOUS** on E.M. IX.

Soil, Sun, and Spacing

The greater the growth-restricting influence of the root stock, the more important it is to plant the trees in a fertile and well drained soil. All fruit trees do best in a sunny location. The space required for each tree depends on the size the tree will reach and the shape to which it will be trained. Apple trees on E.M. IX, when growing as bush trees, can be spaced 10 to 15 feet apart. Similar spacing can be given dwarf pear, peach, and plum trees. Apple trees on a semi-dwarfing root stock (such as E.M. VII) and cherry trees on the Mahaleb root stock require 15 to 20 feet between trees and tree rows.

Planting and Support

Correct planting is important with dwarf apple and pear trees. The union between the variety (or *scion*) and the root stock—that is, the place where the varietal bud was grafted to the root stock



Courtesy N. Y. Agricultural Experiment Station

RED SPY apple on EAST MALLING IX dwarfing stock. Root in man's hand has grown from scion and tends to counteract dwarfing effect of root stock. Scion-rooting can be avoided by planting tree with graft union at least 4 inches above surface of ground

-must not be placed below ground. If placed below ground, the variety may grow its own roots and free itself of the growth-restricting influence of the root stock. A scion-rooted tree becomes large: size control and precociousness are lost.

The E.M. IX apple root stock has a brittle root system which might break when the tree is swayed by the wind. To prevent root breakage, the trunks should be tied to stakes. A very satisfactory method is to tie the tree to a 6- to 7-foot iron pipe which has been driven into the ground before the tree is planted. If holes are drilled through the pipe near the top, wires may be strung to help support heavily laden branches. The wires are bent to form hooks which in turn are hooked to branches bending to the ground under the load of fruit. Dwarf apple trees may also be supported by a wire trellis such as is used for grapes.

To overcome root breakage of the E.M. IX root stock, new methods are under test: methods of constructing dwarf trees by the interposition of a 4- to 5-inch stem piece of a dwarfing stock between standard root stock and the scion variety. (Dwarfing stocks tested are E.M. IX and the recently publicized CLARK'S DWARF stock.) These tests so far have indicated that the dwarfing effect of the stem piece is not so great as that of the dwarfing root stock.

Apples

Varieties. Many apple varieties can be grown successfully as dwarf trees. Certain varieties are better for this purpose than others. CORTLAND, MACOUN, and MCINTOSH are very susceptible to a fungus disease known as apple scab. Varieties less susceptible or nearly resistant to apple scab are an advantage for the home garden. BALDWIN, COX'S ORANGE, GRAVENSTEIN, GOLDEN DELICIOUS, GRIMES GOLDEN, JONATHAN, RHODE ISLAND GREENING, and NORTHERN SPY do well on E.M. IX and are recommended.

Proper **pollination** is as important with dwarf trees as in the commercial orchard. Varieties blooming about the same time, such as GOLDEN DELICIOUS, MACOUN, and NORTHERN SPY, all blooming late, should be planted together. BALDWIN, GOLDEN DELICIOUS, JONATHAN, and RHODE ISLAND GREENING are more likely to set some fruit with their own pollen. Fruit set can be increased by including in the planting one good pollinator, such as JONATHAN.

Thinning of the fruit is advisable when a heavier fruit set has taken place than can be nourished by the leaves of the tree. This must be done not later than mid-June. Only one fruit per spur should be left. It may even be necessary to reduce the crop still further by re-

moving all of the fruits from some of the spurs. Overbearing reduces fruit size and may even reduce the crop for the following year.

Pears

The varieties DUCHESS D'ANGOULEME, BEURRÉ HARDY, BEURRÉ DIEL, FLEMISH BEAUTY, and OLD HOME are entirely compatible with the quince root stock. Some varieties, however, fail to make a strong graft union with the size-controlling root stocks. ANJOU, BARTLETT, CLAPP'S FAVORITE, DANA HOVEY, and TYSON grow on a quince root stock but make a poor graft union that easily breaks if the tree is not supported by either stakes or a trellis. Varieties like BOSC, SECKEL, and SHELDON are incompatible with the quince dwarfing root stock; these can still be grown as dwarf trees by a method known as double-working a tree. A compatible variety forming a strong straight trunk (for instance, BEURRÉ HARDY or the fire-blight-resistant OLD HOME) is grafted on the quince root stock; then the incompatible variety is grafted to the trunk of the compatible one.

Pear varieties usually require cross-pollination in order to set fruit, but DUCHESS D'ANGOULEME and FLEMISH BEAUTY are more likely to set fruit with their own pollen.

Pruning and Training

Dwarf trees, grown as so-called bush trees in contrast with the symmetrical cordons, pyramids, and espaliers, require a minimum of pruning. When a 2-year-old nursery-grown tree is planted, two to three well spaced lateral branches and a leader are selected and all other shoot growth is removed. Each remaining branch is cut back to two thirds of its

length. Weaker lateral branches are cut back to a lesser degree or not at all. One-year-old trees are cut back to a height where the future head is desired, that is, 12 to 18 inches from the ground.

Since heavy annual pruning delays fruiting, pruning should consist of thinning out the shoot growth by removal of the weaker branches rather than systematic cutting back of the terminal shoot growth. After the tree has been bearing fruit for four or five years and is slowing down in vegetative growth, severe pruning back of branches early in the spring is advisable. The main lateral branches, as well as the leader, should be cut back to the older fruiting wood. This reduces the crop for a year or two, but new shoot growth for future crops is stimulated and a sturdy, well shaped tree is the result.

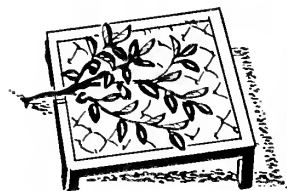
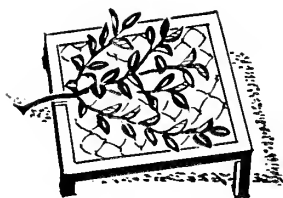
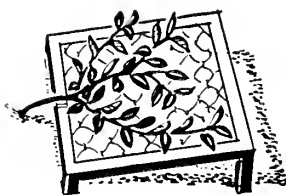
General Care and Yield

There is no reason to believe that dwarf apple and pear trees are short-lived. If they are planted in suitable soil and are given good care they may be expected to produce good fruit for twenty years or more. Dwarf trees should receive substantially the same care as standard trees. A mulch of hay, lawn clippings, or composted leaves and similar materials, placed around newly planted trees and replenished each year, will maintain in good vigor trees planted in good garden soil. Apple trees on E.M. IX root stock, if properly cared for, will begin to fruit the second or third year after planting (depending on the variety) and will be in full bearing at 8 to 10 years of age. Maximum yields for a dwarf apple tree on E.M. IX will be from 100 to 120 pounds of fruit per tree.

MUCH IN LITTLE

The home gardener who wishes to grow many varieties of tree fruits in a small area may graft a number of varieties into the same tree. One branch will produce all the fruit the average person can consume of one variety, if a number are

grown. A tree of each variety requires much space and produces far more fruit than is needed. Instructions for grafting and budding may be obtained from the United States Department of Agriculture and many experiment stations.



FRUIT GROWING IN NORTHERN SWEDEN

*Testing hardiness of varieties for
the Far North*

Gunny Larsson

THE northernmost horticultural research station of Sweden is situated at the State Experimental Farm of Öjebyn, between latitude 65 and 66 degrees north. The growing season is very short here, but light conditions are most favorable. We have 404 more hours of light than the southernmost part of Sweden in the time from May to September, but twelve weeks less in the growing season. The snow does not disappear until the end of April, and sowing is still going on in the first half of June. Actually we have only two months of summer—July and August. The average temperature for the whole year is just above freezing, and for May to September, about 52° F. The precipitation comes mostly as snow in the winter or as rain at times when we do not need it; the average for the whole year is 18.4 inches.

As experiments in horticulture in this part of Sweden are just beginning, we are first testing the hardiness of obtainable material. Plants that are to be in a dormant condition in time for the winter must ripen quickly in the autumn and so must be suited to a short summer.

Apples

At Öjebyn the first stock-and-variety trial with apples was planted in 1946, when the research station began its existence. ANTONOVKA and TRANSPARENTE

WHITE were worked to various stocks. ANTONOVKA does rather well on all stocks, but the other variety is not hardy. The Russian HIBERNAL is the best tree in the field. MELBA and SUISLEPPER are quite hardy and produce apples every year. MELBA is a delicious apple in this latitude and is ripe in the middle or end of September. I should think it would keep until Christmas.

In the spring of 1950 we planted a variety trial with mostly Finnish and a few Russian and Swedish local varieties. They were all worked to "A2," the only stock that is absolutely hardy. It was selected at Alnarp in south Sweden and has been very much spoken of lately. Two trees of each variety were planted differently: one upright, in the ordinary way; the other at an angle of about 40°, to make a creeping tree, as illustrated above. The purpose of this is to find out which one will endure the winter better. Probably creeping trees will be important for this part of the country. They are covered with snow in the winter, and in the summer they get more heat because of their nearness to the ground; thus they will produce apples earlier. Besides apples we are growing some sour cherry varieties, such as SKUGGMORELL and OSTHEIMER, and last spring we planted a few Canadian plums, supposed to be hardy.

Currants and Gooseberries

While apple growing cannot be of economic value so far north, the culture of bush and ground fruits can. Among bush

fruits black currants seem to be most important, owing to the high content of vitamin C. Here at Öjebyn we have two rather big variety trials, one with different types of very hardy varieties, collected in the northernmost parts of Sweden. They are compared with the ordinary ones such as BOSKOOP GIANT (not very hardy), and BRÖRTORP and ÅSTRÖM, both hardy Finnish varieties. BRÖRTORP is reliable in the North of Sweden and comes into bearing early. In the other trial we are testing mostly English varieties such as WESTWICK CHOICE, WESTWICK TRIUMPH, WELLINGTON X, XX, and XXX, INVINCIBLE PROLIFIC, and DAVIDSON'S EIGHT.

In our gooseberry trial, planted in autumn 1947, we have some very hardy Swedish and Finnish local varieties: SCANIA, UMEÅ LANTSORT, SÖRÅKER LANTSORT (Swedish), PELLERWO (Finnish), and OLAVI; the English CHAMPION and TRIUMPHANT are also very good; both give high yield, especially the first one.

Raspberries and Strawberries

In spring 1947 a variety trial with raspberries was laid out, where ASKER, MARLBOROUGH, and MIRANDA seem to be hardiest. ASKER is a Norwegian variety, long grown in northern Sweden. It has a very delicious aroma but gives a poor yield. MIRANDA is new, raised at Alnarp. It seems most promising, giving a very high yield and being quite resistant to frost and drought.

The first strawberry trial, planted in 1947, was thoroughly damaged during the winter 1948-49, when the plants were covered with ice instead of snow. In that trial ABUNDANCE seemed to be the hardiest one; this variety is grown everywhere in north Sweden and in Finland too. In 1950 we planted a new trial with different types of ABUNDANCE, DEUTSCH EVERN, INDRA (new variety, raised at Alnarp), and others. The earliest variety is DEUTSCH EVERN; we started picking from it the end of July this year; but everything is about two weeks later than normal.



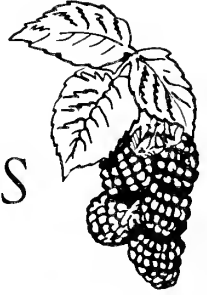
Author Courtesy

Recording results of gooseberry trial

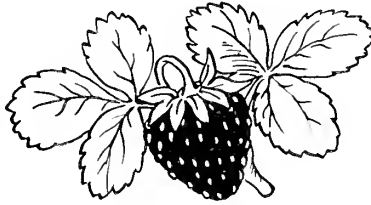
More or less private cultivating experiments are going on with *Rubus arcticus*, which is said to be the most aromatic and delicious berry in the Northern Hemisphere. If one could join the lovely flavor of *Rubus arcticus* with the high vitamin C content of *Rubus chamaemorus* (cloudberry), getting a hardy, easily cultivated plant, no more could be wished. But so far this is only a desideratum.

Regarding pests and diseases on fruit trees and bush fruits here at Öjebyn, we get them with the material from the South and they seem to get on splendidly. We have rather severe attacks of red spider, especially on raspberries but also on strawberries. Scab on apples is rare, probably owing to dry summers.

At the Horticultural Research Station we also have trials with vegetables, perennials, roses, tulips, and hedge plants. The great number of visitors to the farm shows a tremendous interest in what is going on here. Many private persons have started growing soft fruits, flowers, and vegetables of good varieties, not known to be hardy five to ten years ago.



GROWING THE SMALL FRUITS



How to make a real success of it

George L. Slate

THE small fruits (or berries) have their own special cultural requirements, which must be met if these fruits are to be grown successfully.

Strawberries

Spacing. The strawberry plant in a fertile soil produces far more runners and new plants than are needed for a full crop. Unless these surplus plants are treated as weeds and ruthlessly removed, they compete with each other for moisture and plant nutrients and greatly reduce the crop. For proper spacing, the new runner plants should be placed around the mother plant about 6 inches from each other until the row is filled out to a width of 18 inches with spaced plants. Runners developing thereafter are removed promptly before they take root.

Mulching. The strawberry bed must be mulched for winter to protect the crowns of the plants from severe cold. If temperatures much below 20° F. occur when the plants are not covered with snow or with a mulch, the crowns may be injured. The mulch also protects the plants from heaving due to alternate freezing and thawing of the soil during the winter. In the spring the mulch conserves moisture, keeps down weeds, and protects the berries from splashing by heavy rains. Wheat and oat straw and marsh hay are excellent mulching materials; any of these should be spread over the strawberry plants to a depth of 3 or 4 inches before temperatures drop below 20° F. but after some hard frosts have occurred.

In the spring, just as the new growth is starting, part of the mulch is removed from the plants (with a fork) to the space between the rows. The leaves and flowers push through the remaining straw, which serves as a cushion for the berries.

Raspberry Diseases

Raspberries are subject to **virus diseases** and one **fungus disease** (orange rust), which are prevalent in wild brambles and may easily spread to cultivated plants near them. These diseases may also be present in run-out cultivated raspberries. Before setting raspberries, it is desirable to eliminate wild red and black raspberries in waste land, fence rows, and run-out garden plantings, for at least 200 yards from the proposed new planting. Where it is not possible to get rid of diseased plants, one should choose red raspberry varieties that are resistant to the virus-caused mosaic disease. MILTON, MARCY, INDIAN SUMMER [illustrated in the color section], and possibly SEPTEMBER are mosaic-free sorts. None of the black or purple varieties are really resistant to the mosaic. The COLUMBIAN purple raspberry is a mosaic-virus carrier but is so tolerant of the virus that it performs well even though infected. It should be planted only by itself.

Verticillium wilt, a soil-borne fungus disease, is often injurious to black and purple raspberries in gardens. It may be introduced into the soil by members of the nightshade family, among which are the common garden vegetables tomatoes, peppers, eggplants, and potatoes. It is a good practice to avoid planting

black and purple raspberries on soils where these vegetables have grown during the past three or four years. These crops should not be planted between the raspberries.

Winter Injury to Brambles

The canes of brambles are often winter-injured. Frequently the injury is due to late growth of the berry canes, which may be stimulated by overfertilization with nitrogenous materials, by late cultivation, or by abundant fall rains after a summer drought. Home gardeners sometimes use manures to excess on raspberries, not realizing that the rich diet may keep the canes growing so late that they are not matured when severe weather arrives. The remedy is to check late growth by discontinuing cultivation after the crop is harvested and letting the weeds grow, or by sowing a cover crop of buckwheat to compete with the berry canes for the rest of the growing season. The cover crop is worked into the soil the following spring.

Support

Brambles are often supported by a trellis or by stakes, but this is usually not necessary and the labor and materials may be used to better advantage elsewhere. The **fall-bearing raspberries**,



Proper spacing of new strawberry plants around mother plant which produced the runners



Courtesy N. Y. Agricultural Experiment Station

BAILEY blackberry, a new and promising variety for the home garden

however, should be supported by trellis or stakes, as the fall crop is borne at the ends of the canes where its weight causes it to drag on the ground, with consequent bruising and soiling of the berries.

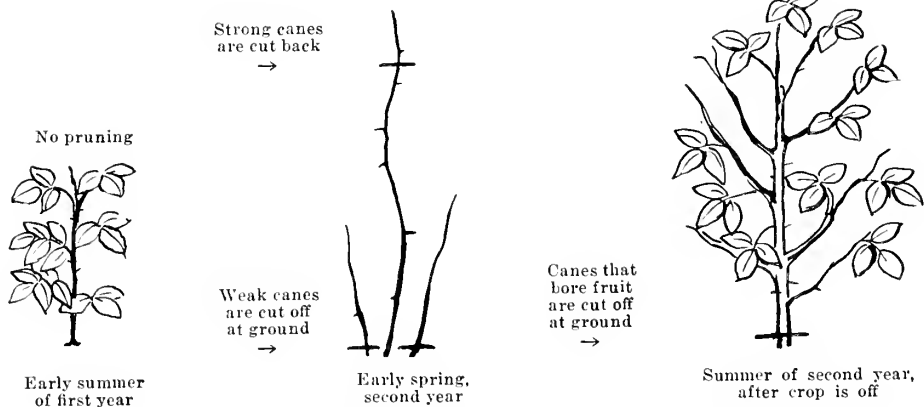
Pruning

The pruning of the brambles is based upon the biennial nature of the canes. They grow one year, bear fruit the following year, and then die. The roots live indefinitely and continue to send up new sets of canes.

Beginning. Pruning may well start as soon as the crop is off, in early August. At this time the canes that bore the crop are removed to provide more room for the new canes.

Dormant Pruning. The following spring, before growth starts, the weaker *red raspberry* canes are thinned out. The stronger canes are left, spaced 6 inches apart in a row about a foot wide; these are cut back about a fourth. *Black* and *purple raspberries* are thinned out to five or six of the stronger canes in each hill. The laterals (branches) are shortened to 6 or 8 inches for the black varieties, and 10 or 12 inches for the purple varieties. *Blackberry* branches are left 15 to 18 inches long.

Growing Season. The tips of the new shoots of *black raspberries* should be



How to prune a red raspberry bush

nipped off as soon as they are 18 inches high, to make the canes branch. If this is not done the canes grow several feet long, sprawl all over the place, and are difficult to manage. The topped canes make sturdy, compact, self-supporting bushes. *Purple raspberries* are nipped about 6 inches higher than the black varieties. The *red* varieties, which do not branch much, should be allowed to grow unchecked. The new shoots of *blackberries* are usually topped at a length of about 3 feet.

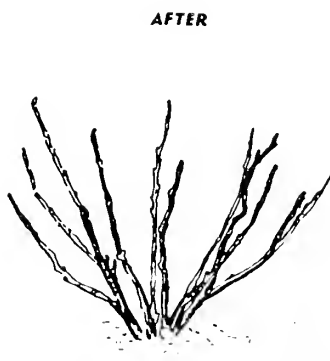
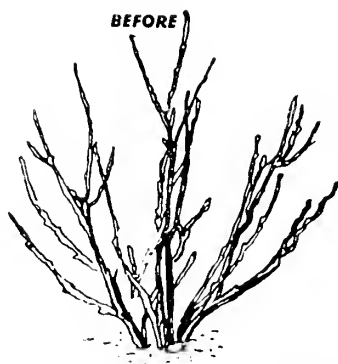
Suckers. *Red raspberry* and *blackberry* plants produce a multitude of suckers which spring up around the old crowns, even to a distance of several feet. Unless most of these are eliminated and the remainder limited to a fruiting row about a foot wide, the planting will soon become an unmanageable thicket. The surplus suckers are removed by cultivation or frequent use of a sharp hoe. *Black* and *purple raspberries* do not sucker, and all new growth comes from the same crown each year.

Currants and gooseberries produce far more canes than are needed for fruit production. The weaker canes should be thinned out so that a pruned mature bush consists of about nine canes equally divided among the 1-, 2-, and 3-year-old canes. Older canes should be removed.



Roche

Cellophane bags for protecting grapes in the home garden



Courtesy N. D. Agricultural College and American Fruit Grower
Currant bush before and after pruning



EVERBEARING STRAWBERRIES

Ideal for the home garden

Wesley P. Judkins

HAVE you tried the new spaced-plant, sawdust-mulch method of producing everbearing strawberries? If not, you are missing an opportunity for raising fine luscious berries for your family. Actually the method is not very new; it was originated by Karl Michener of Burton City, Ohio, some twelve or fifteen years ago. Others have followed modifications of this system but have never perfected it.

A back-yard planting 40 feet long and 15 feet wide may produce 100 quarts of strawberries the first year. Commercial growers can secure yields of 6000 quarts or more per acre.

Most people who have tried to raise everbearing strawberries in the past have secured very low yields of small berries. The reason for this appears to be that the plants were allowed to develop a matted row, as is commonly followed with June-bearing sorts. The everbearing type will not stand the competition of the matted-row system; and it requires a mulch to maintain cool soil conditions and to conserve soil moisture during the hot dry weather of late summer, when the fruit is ripening.

Planting

For best results the everbearing strawberry planting should be established on

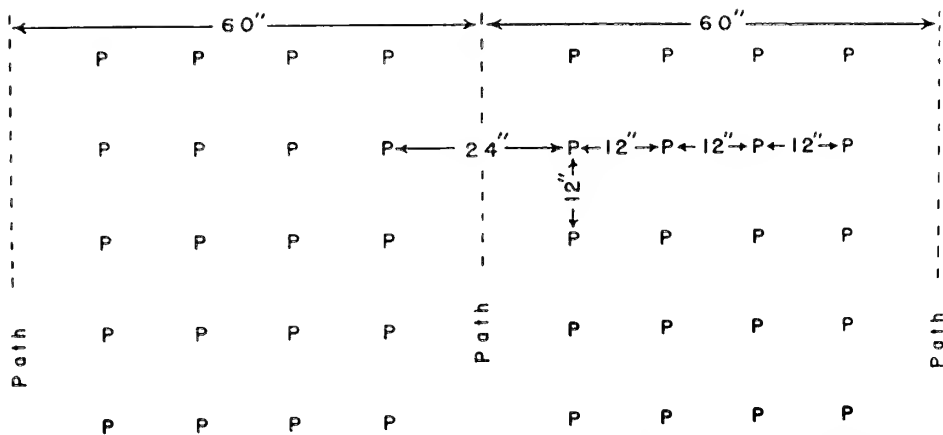
fertile, well drained soil. The land should have been under cultivation for at least a year or two to reduce the difficulty of controlling white grubs and weeds.

The plants should be set out just as early in the spring as the soil can be prepared. Early April is the preferred time in areas having climatic conditions such as those in Connecticut, southern New York, Pennsylvania, and Ohio. The planting date in northern New York and Massachusetts would be a little later.

A four-row-bed system should be followed, in which the plants are set a foot apart in rows that are a foot apart. Four such rows are planted and then a 2-foot alley is left, to provide a path along which to work when picking the fruit or removing weeds, blossoms, and runners.

Some growers in the past have followed a three-row system in which a center row was set out and runner plants were trained to establish two additional rows, one on each side of the original row. The four-row system, in which all runner plants are removed, produces much earlier and larger yields of berries and is now recommended for both home and commercial planting.

The home planting of the 40- by 15-foot area requires 500 plants, which should produce 100 quarts of berries the first year. Such a yield is adequate for a family of four people and provides fresh fruit as well as a surplus for freezing or canning.



Author Courtesy

Plan for planting everbearing strawberries. "P" indicates parent plants. Four-row beds may be as long as garden space permits

Weed Control and Mulch

The first crop of weeds will usually appear within two or three weeks after planting. These should be controlled by hoeing. The plants are too closely spaced to allow for the use of a cultivator.

After this first hoeing, the entire area should be covered with a layer of sawdust an inch thick. This mulch is very important for conserving soil moisture, and helps suppress the growth of weeds. Some weeds will usually grow up through the sawdust within a few weeks after it is applied. These must be pulled up, because hoeing would mix the sawdust with the soil and eliminate its mulching effect. After this first weed pulling has been done, weed control should be relatively easy during the rest of the season if the planting is on well prepared soil.

Blossom Removal and Fruiting

All blossoms that develop on the newly set plants should be removed until early July. This operation is important if the plants are to produce a large crop the first year. The exact date for discontinuing blossom removal depends on the vigor of the plants. If the plants have become well established and are growing actively by the first of July, the flowers may be allowed to develop fruit.

Under such a schedule the first ripe berries will be ready for picking in early August. If the plants are making poor growth because of late planting or drouth, blossom removal should be continued until the middle of July.

After fruit production starts in August, ripe berries may be harvested about twice each week until frost stops growth in October. The sawdust mulch helps to conserve soil moisture during the late summer. If an extended drouth occurs, the crop can be greatly increased in size and quality by the use of irrigation.

Runner Removal and Plant Raising

All runners should be removed from the fruiting plantation as fast as they develop. This is essential if the highest yields are to be secured.

In some cases the grower may wish to raise his own plants. This may become a profitable sideline because everbearing strawberry plants are more costly than the June-bearing types. If plants are to be produced for the next year's planting, a few extra rows should be set out and allowed to develop into a matted row of runners. All blossoms should be removed until late July or early August to promote vegetative growth rather than fruit production.



Courtesy Virginia Polytechnic Institute
GEM everbearing strawberries

Type and Amount of Sawdust

Either hardwood or softwood sawdust in a fresh or weathered condition may be used. Sawdust does not make the soil acid as many people suppose. In some instances a temporary nitrogen deficiency may develop but this can be remedied by the use of a quickly available nitrogen fertilizer. Nitrogen deficiency is not a problem when the sawdust is used on the surface, but may develop when the material is mixed with the soil.

About 2 cubic yards of sawdust are

needed to mulch the 40- by 15-foot home garden strawberry patch. If sawdust is not available, peat moss, ground corn-cobs, fine shavings, or chopped straw may be used.

The sawdust mulch appears to give adequate protection over winter. A thin renewal layer may be needed in the fall if the spring application was too light. A full inch of mulch should be maintained.

Varieties

GEM and SUPERFECTION have given the best yields of all readily available varieties which have been tested to date. STREAMLINER produces a somewhat smoother and higher-quality berry than either GEM or SUPERFECTION, but usually gives a smaller total yield of fruit.

Hand Labor, Large Yield

It should be emphasized that the sawdust-mulch system of producing everbearing strawberries is not an easy method of culture. A large amount of hand labor is required. It is, however, rather ideally adapted to the back-yard garden. Large yields are possible from a small area. The home owner can have fresh berries during most of the summer and freeze the surplus for use during the winter. The GEM and SUPERFECTION varieties are especially good for freezing.

STRAWBERRY WEEDING



Courtesy N. Y. Agricultural Experiment Station

Geese are being used very effectively to weed strawberry beds. They do not eat strawberry foliage or fruit, but do eat grasses and many (though not all) broad-leaved weeds. Four or five geese to the acre, costing about \$3 each, will keep the strawberry bed free of weeds than many times their cost spent on hoeing and cultivation. A 3-foot fence will confine them. Shade, an abundance of clean drinking water, and cracked corn or duck pellets after the weeds are cleaned up, will take care of their needs.

STRAWBERRIES IN SMALL AREAS

In small gardens strawberries may be grown in barrels or pyramids, as illustrated. If properly managed, excellent crops may be obtained.

The holes in the barrel should be about an inch in diameter and about 10 inches apart. As the barrel is filled with soil (which is packed down firmly), the plants are inserted. A core of coarse sand in the center of the barrel permits the water to penetrate readily.

The barrel should be in the full sun, and should be watered frequently and fertilized occasionally with a complete fertilizer dissolved in water. Runner plants are removed as they appear. Several inches of straw should be wrapped around the barrel in late November.

When everbearing varieties are used, the blossoms are removed until the first of July; then fruiting is permitted.

The pyramid is managed in a similar manner but without the core of sand.



Roche

Strawberry barrel

Strawberry pyramid

Robert A. Wesselmann, courtesy N. Y. Agr. Exp. Station





BLUEBERRIES

In the home garden

George M. Darrow

IN 1938 I visited the blueberry planting of Mr. and Mrs. Dirks, in western Massachusetts. They started their blueberries about 1924, and the garden was as fine as ever when I saw it again in 1949. Their plants are on sloping upland near their home, and for twenty-five years they have mulched the planting with sawdust. They apply additional sawdust every few years so as to keep down grass and weeds. They have built a frame which is covered with tobacco cloth during the ripening season to keep out birds.

Mulching and Bird Control

In general in the eastern United States, and especially in the vicinity of Brooklyn, the two practices most important for the success of home blueberry gardens are

just the two used by the Dirkses—mulching with sawdust (or leaves) and covering to keep out birds. In my own garden in Maryland I use both leaves and sawdust for mulch—leaves as far as they go and sawdust for the other bushes. Where quack grass or strong perennial weeds would come through the mulch, I first laid heavy wrapping paper or cardboard and then put on the leaves and sawdust. I have used any kind of leaves available—bamboo, black walnut, apple, mulberry, and others—and the mixed sawdust that I can get from a neighboring sawmill. The leaves are piled deep enough to smother the grass, and the sawdust is about 6 inches deep over the whole surface.

Soil

Though the ideal soil for blueberries is a loose sand-peat one with some field soil mixed in, most soils of the states along the Atlantic Coast can be made satisfactory. A possible exception is

a soil mixed with plaster and lime near a building. In that case a hole at least 2 feet square and a foot deep should be dug and filled with acid woods soil or with baled peat mixed about half-and-half with good soil.

A good blueberry soil should be definitely acid (4.0 to 4.8 pH) and contain at least a fair amount of organic matter. If it tests less acid (5.0 to 5.5 pH), regular applications of sulfate of ammonia usually result in healthy growth. If the soil is only slightly acid (5.5 to 6.5 pH), then for medium loams powdered sulfur should be spread over a 3-foot circle where each bush is to be planted and should be mixed well in the upper 10 inches of soil. On the lighter soils about 2 pounds of sulfur, and on the medium loams 4 pounds are needed for ten plants. For good yields, the blueberry should not be in the shade.

Planting, Fertilizing, and Growth

Two-year-old plants are usually best for planting; strong 2-year plants should be about 15 inches high. They are usually set in the early spring, as soon as the land can be prepared; but from southern Connecticut southward it is usually bet-

ter to plant in the fall—October or November. The bushes should be planted about 6 feet apart each way. After they have started growth, a mixed garden fertilizer may be spread in a band 6 inches to 12 inches out from the plant the first year, and in a wider band as the bushes grow older. About 1 ounce of fertilizer per plant is used for each year of its age up to 8 years. After the first year the fertilizer is applied twice, once in April as the buds start, and again about June 15. If a 6-inch mulch of sawdust is used, three times as much fertilizer should be used. If leaves are used as mulch, twice as much fertilizer should be enough for a 3-inch depth of leaves after they have packed in the spring.

The plants should make a nice growth the first year, often 6 to 12 inches. They should bear a small crop the third year, and a larger crop each year thereafter. When full-grown they are usually 6 to 8 feet high and about 6 feet wide.

Varieties

It is a little over thirty years since blueberry culture first became successful. About 1909 the late F. V. Coville and



RUBEL, the best wild blueberry ever found



BERKELEY, a new variety with large light blue berries

Courtesy U.S. Dept. Agriculture

Miss Elizabeth White began searching the wild for the best native bushes.* The selected bushes were propagated, and about 1918 the first shipments were made from a cultivated field at Whitesbog, N. J. Breeding work was started in 1909, and in 1920 three varieties resulting from this work were named and introduced. Twenty-two varieties from the breeding work have now been named, the later named varieties replacing some of the earlier ones. Extensive breeding work is still being carried on, and better new varieties can be expected—better in flavor, size, color, productiveness, hardness, or season of maturing.

The home gardener has a goodly number of varieties from which to choose. For two persons, two plants each of three varieties may be enough; for four persons, ten bushes—two each of five kinds. At least two varieties should be in every planting, for cross-pollination.

In the region near Brooklyn and south to Virginia, the varieties to be considered should include, in order of their ripening: STANLEY, BERKELEY, PEMBERTON, ATLANTIC, DIXI, and COVILLE. BERKELEY, COVILLE, and DIXI are larger-fruited than the other varieties; ATLANTIC and PEMBERTON are only slightly smaller; and STANLEY somewhat smaller still. BERKELEY fruit is the lightest blue in color and the largest. COVILLE is the most tart, as well as the latest. STANLEY has the highest aroma; in fact, it is so aromatic that some do not care for it. ATLANTIC is considered especially fine frozen, but the others are very good also. PEMBERTON has the most vigorous bush, but all six varieties suggested are vigorous. In the vicinity of Brooklyn, STANLEY begins to ripen about July 1, and COVILLE about August 1, lasting through August.

In North Carolina WOLCOTT and SCAMMELL are good home-garden varieties. In eastern North Carolina and south to northern Florida and west to Louisiana, the rabbiteye, a southern blue-

berry species (*Vaccinium virgatum*) is especially adapted to home gardens, for it is much more resistant to drought and heat and more vigorous than the more northern highbush blueberry (*V. corymbosum*). CALLAWAY is new and is probably the best of the rabbiteye varieties, but it must be planted with another variety, COASTAL, MYERS, or CLARA, for cross-pollination.

Harvest

For bird control, covering the bushes with tobacco cloth is generally the most satisfactory. Some growers have built permanent wire cages (1-inch mesh) to enclose their blueberries. Various other methods to keep birds away have been tried with varied success—mouse traps, toy snakes, highly polished metal strips or inflated paper bags hanging from cords strung over the bushes, stuffed owls or tethered live hawks on posts, and automatically discharging acetylene guns. Birds soon get used to these devices and continue to eat their favorite food—blueberries. Catbirds near the house and robins farther afield are generally the most destructive, but brown thrashers, cardinals, mocking birds, and many others take their toll of fruit.

Full-grown bushes 8 or more years old may bear 8 to 10 quarts each. Even higher yields can be obtained. In the North, unpruned bushes may bear more than pruned ones; however, the berries on unpruned bushes are relatively small. Light pruning, taking out the small slender branches and leaving the strong ones, is considered best. Farther south pruning of the highbush varieties is essential, for unpruned bushes may set so heavily that many of the berries do not ripen normally and large parts of the bushes die.

The blueberry lends itself well to plantings near the home, for it is attractive the year through. In May the bloom is pinkish white; in the fall the leaves turn reddish; and in the winter the red, green, and reddish-green twigs and red buds are attractive.

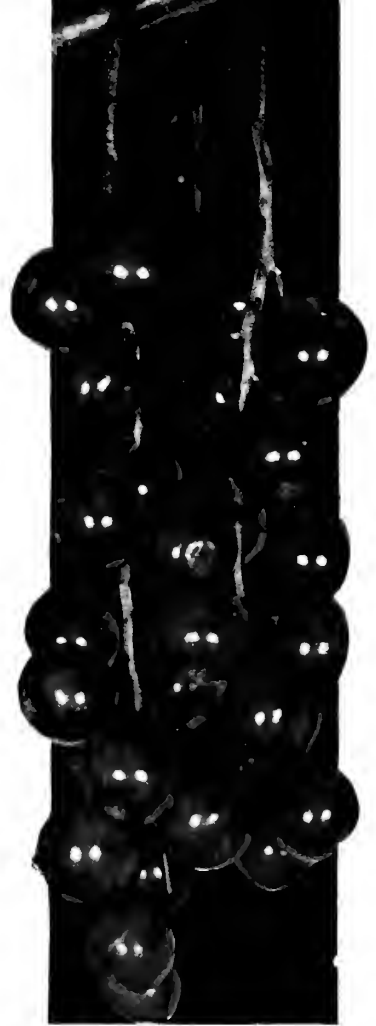
*“Cultivated Blueberries” by Elizabeth C. White, PLANTS & GARDENS, Spring 1947.



Cultivated blueberries are as good as they look, though some people hold that the small wild berries are sweeter. The highbush blueberry is also an ornamental shrub throughout the year: its flowers a delight in the spring, its autumn foliage a brilliant red, and its winter twigs also red.



Blackberries are rarely found in the market in first-class eating condition. The bushes are easy to grow, have few pests or diseases, and are ornamental as hedges.

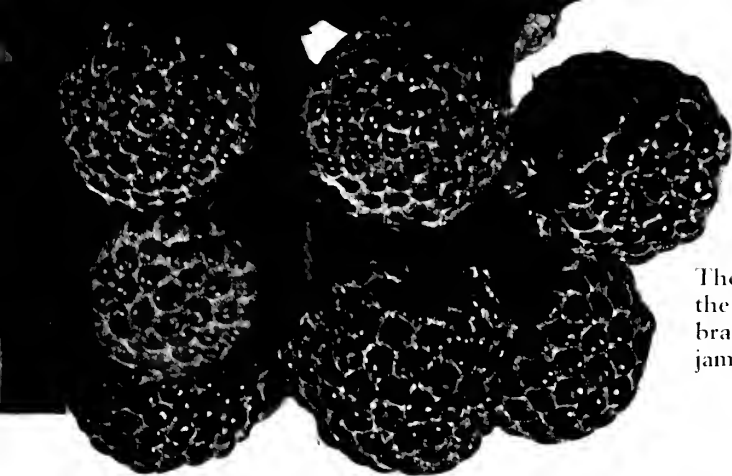


The currant **RED LAKE** is splendid for home gardens. It has large berries and long, well-filled clusters.

Currants and gooseberries should **NOT** be planted within a thousand feet of white pines, because they harbor one stage of blister rust, a serious disease of white pine.

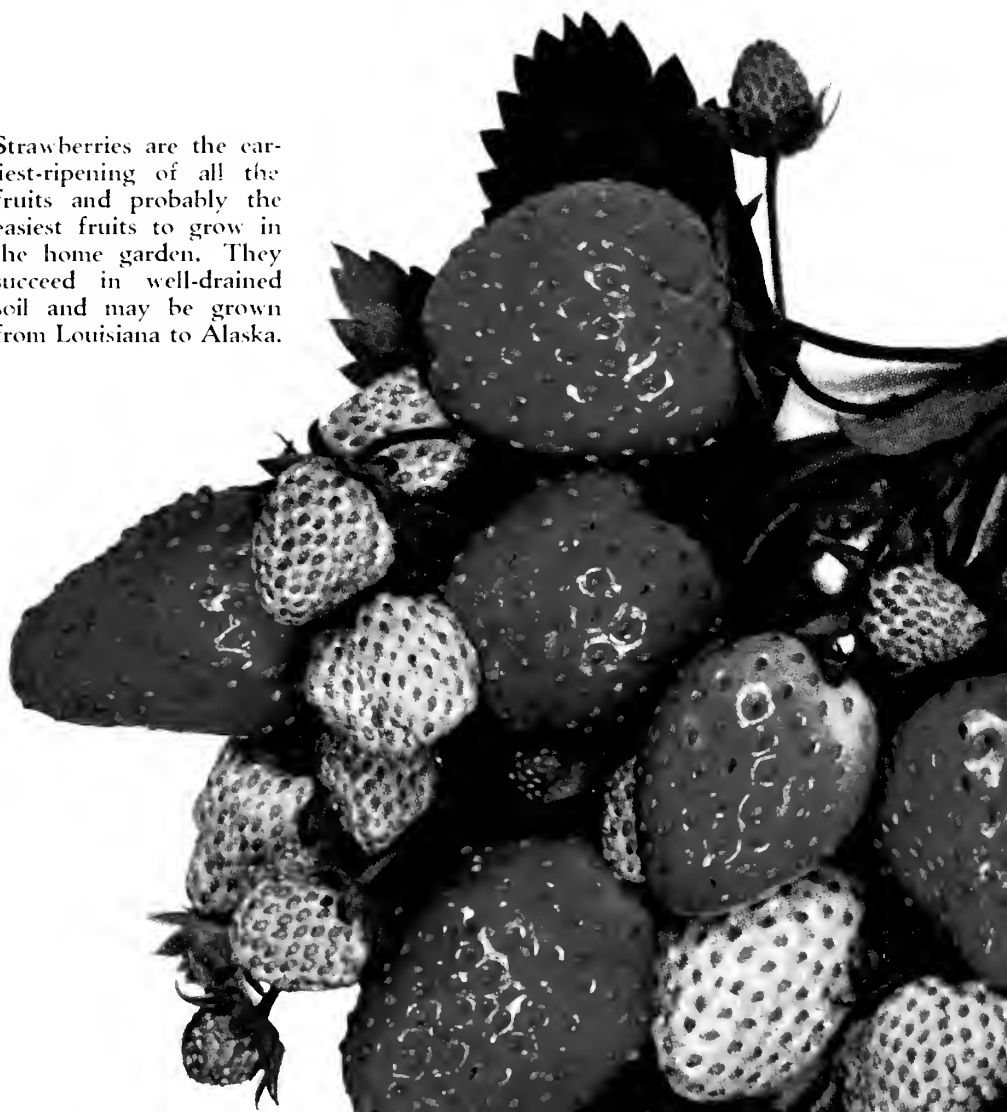


Red raspberries **INDIAN SUMMER**.



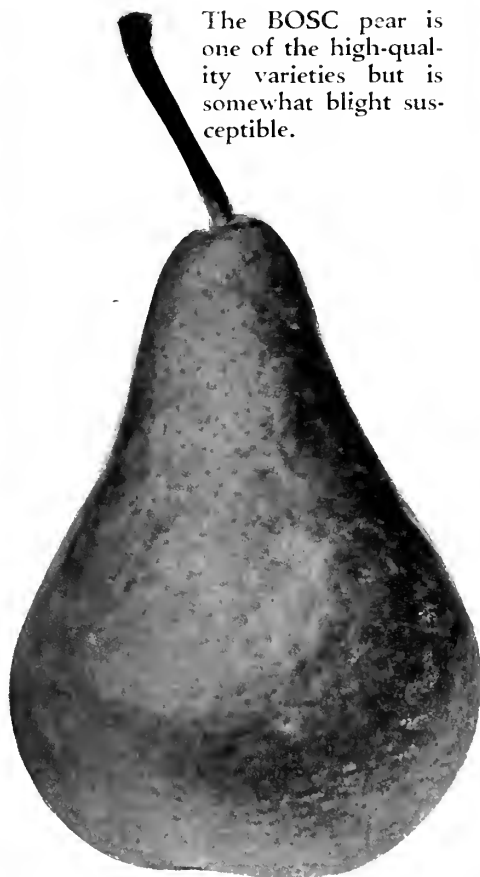
The black raspberry is the most richly flavored bramble. It is best for jam, jelly, and canning.

Strawberries are the earliest-ripening of all the fruits and probably the easiest fruits to grow in the home garden. They succeed in well-drained soil and may be grown from Louisiana to Alaska.





DAMSON plums are excellent for jam, jelly, or plum butter.



The BOSC pear is one of the high-quality varieties but is somewhat blight susceptible.



The SECKEL pear is small-fruited but noted for its rich, sweet, and spicy flavor; it is more blight resistant than most varieties.

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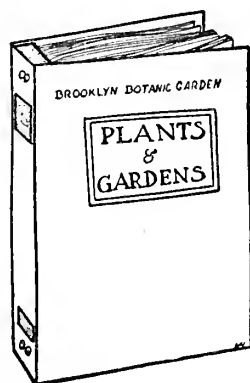
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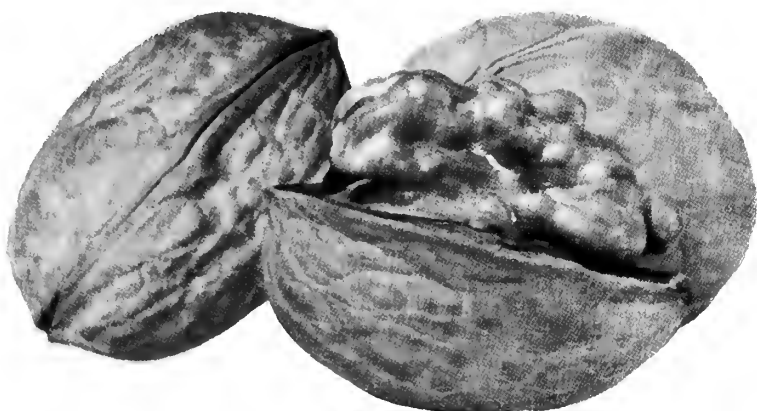
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Reminder:

Don't close this copy of PLANTS & GARDENS without having ordered a binder for your new issues—or binders for previous years.

MONTMORENCY is the best of the sour cherries. The trees are hardy, easily grown, and generally free from disease.



Persian, or English, walnuts can be grown farther north than is generally realized.

Trees of named varieties are superior to seedling trees often sold.

Chinese chestnuts. Since the American chestnut is very susceptible to the blight, the resistant Chinese chestnut is the best to plant for nuts.





The peach is generally considered the most delicious fruit of temperate regions. The trees are easy to grow and come into bearing at an early age.

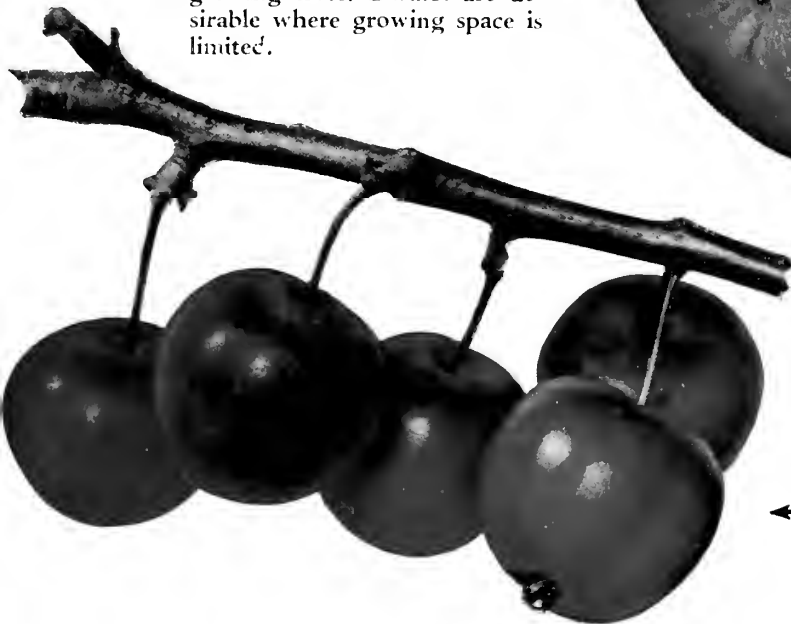


The BROWN TURKEY fig can be grown farther north than is usually supposed; but as far north as Long Island, it needs special protection for the winter.



GREEN GAGE plums are good for home planting in the Northeast and on the Pacific coast. They are of the highest quality as dessert plums and are well worth wider culture.

The apple is the hardiest of the fruit trees. There are varieties for every taste—available as dwarf or as medium- or large-growing trees. Dwarfs are desirable where growing space is limited.

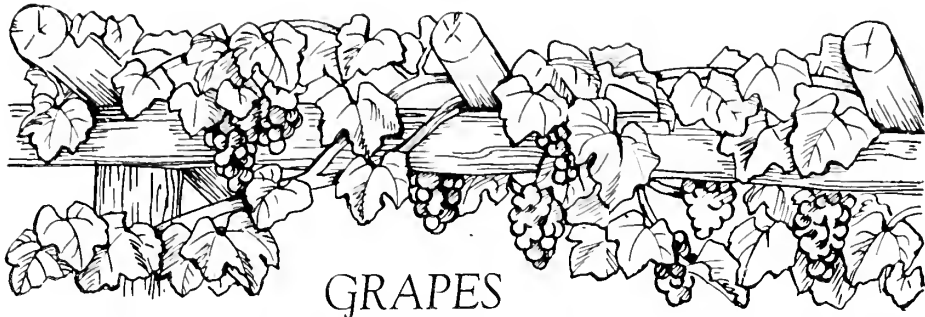


DOLGO crab apples are excellent for jelly. The tree is a handsome ornamental from blossom time to September, when the ripe fruits are bright red.





GOLDEN MUSCAT grapes are excellent for home gardens. They are of fine quality, with clusters and berries very large; they ripen about ten days later than CONCORD.



How to prune and train them

Nelson J. Shaulis

The object of this article is to present suggestions that can guide the home gardener to prune and train his grapes. We may define our terms as follows:

Parts of the Vine

Trunk: The main body, or stem.

Arms: The main branches, or extensions, of the trunk.

Head: The region of the trunk from which arms, or canes, arise.

Old wood: Any part of the vine older than one year.

Shoots: New leafy growths developing from buds. They are called *shoots* during the growing season. After the leaves fall they become *canes*.

Canes: The dormant shoots grown the past season, or shoots that have become woody.

Laterals: The side branches of a shoot or cane.

Spur or renewal spur: A cane cut back to a short stub, usually one or two buds long, to produce next year's fruiting cane at a desired location.

Nodes: The joints on shoots or canes where leaves and buds are attached.

Internodes: The wood of shoots or canes between the nodes.

Suckers: The shoots arising from below the ground.

Water sprouts: The shoots arising from buds along the trunk.

Grapes produced in 1952 will be on shoots arising from canes that grew in 1951. Each of these shoots arises from

a bud at a node on one of the canes left for fruiting. If the vine is left unpruned, shoot growth will be weak and leaves and clusters small, and the fruit will not ripen. Pruning removes over three quarters of the previous year's canes.

Systems of Pruning

Most gardeners prefer to prune their vines to the Four-arm Kniffin system, shown in the diagram on page 195. If the vine were more vigorous, one, two, or even three additional canes would be left along the top wire. If the vine were less vigorous, the two canes along the lower wire would be cut back to two-bud spurs. The gardener who wished to use the Umbrella Kniffin would have two to four canes (of about twelve to fifteen buds each) coming from the top of the vine over the top wire, and would tie them to the bottom wire at a distance of 1 or 2 feet from the trunk.

Vines of Bearing Age

Pruning directions vary for different varieties, but *CONCORD* may be used as an example. We shall consider that the vines are of bearing age and that they are growing on a vertical trellis, trained to the Four-arm Kniffin system.

Time to prune. Grapes may be pruned any time in the period between leaf fall in the autumn and bud swelling in the spring. The bleeding of spring-pruned grape vines is not considered harmful.

Kind of canes to save for fruiting. The canes should be pencil-size ($\frac{1}{4}$ inch) or larger in diameter at the fifth internode from the base of the cane. Dark brown canes are preferred.

Amount of fruiting wood to retain.

The number of buds that should be left on the vine after pruning depends on the vine vigor. If the vine has made weak growth it can not mature a big crop of fruit, and the pruning should be severe. If the vine growth is vigorous (if it has ten canes more than 8 to 10 feet long), a larger number of buds may be left for fruiting. If the vine is average, all the last year's cane growth should be pruned off except six 10-bud canes. All the 1-year prunings should be tied in a bundle and weighed. If the prunings weigh less than a pound, only twenty buds should be left on (two 10-bud canes). If the prunings weigh a pound, thirty buds should be left on (three 10-bud canes). If the prunings weigh 2 pounds, forty buds; 3 pounds, fifty buds; 4 pounds, sixty buds (six 10-bud canes). This pruning scale is known as the 30 + 10 scale: leaving on thirty buds for the first pound of 1-year prunings and an additional ten buds for each additional pound of 1-year prunings.

In addition to the fruiting canes, it is suggested that two to four 2-bud spurs be left near the trunk.

Vines on arbors. Many back yards have arbors covered with grape vines. The pruning of these grape vines may be guided by the same rules used for pruning grapes on a trellis. The vines should be pruned each year, and the fruiting canes after pruning should be ten to fifteen buds long.

Neglected vines. If the vines are tangled and matted together because of several years' neglect, it is suggested that:

1. An estimate be made of the vigor of the canes which grew during the past year. It is likely that they are small in diameter (under $\frac{1}{4}$ inch) and average less than 5 feet in length.

2. The most vigorous canes be selected which originate 1 or 2 feet from the top of the arbor or just at the edge of the arbor. The number of canes selected will depend on the amount of vine

growth made, as discussed in the paragraph on "amount of fruiting wood to retain on the vine." If only one vine covers a large arbor (more than 100 square feet), it is possible that retaining eight or more canes would be the proper pruning severity.

3. All the vine be pruned away except the canes for fruiting and the trunk and arms supporting them.

4. The canes for fruiting be tied up to or over the top of the arbor; this tying should space the canes evenly.

Young Vines

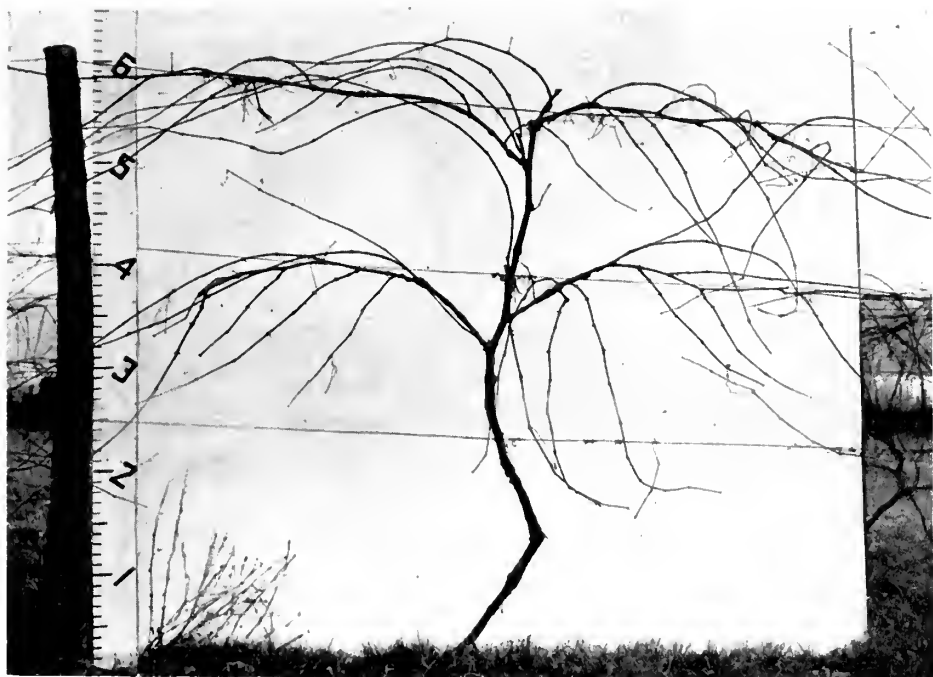
The First Year. When the grape vine is planted, it should be pruned very severely—that is, so that only two buds or nodes remain on one cane. From these two buds and from other buds at the crown of the vine, many shoots will grow. The alert gardener will stake the vine and frequently remove all shoots and suckers except the most vigorous one, which is tied to the stake so that it grows vertically to form the trunk of the vine. The trellis should be erected in the summer or fall of the first year.

The Second Year. The best cane of the vine is pruned to a height of not more than 6 feet. All other canes are removed. This best cane is tied vertically to the trellis. In early June all the blossom clusters should be pinched off the shoots, to permit the vine to make a large amount of shoot growth.

The Third Year. Depending on the vigor of the vine, canes are retained for fruiting as for a mature vine. If the growth has been vigorous (has yielded a pound of 1-year prunings) two 10- or 12-bud canes for fruiting may be left along the top wire and two spurs at the bottom wire. If the growth has been weak, the vine should be pruned the same as a vigorous one, but all blossom clusters must be removed in early June.

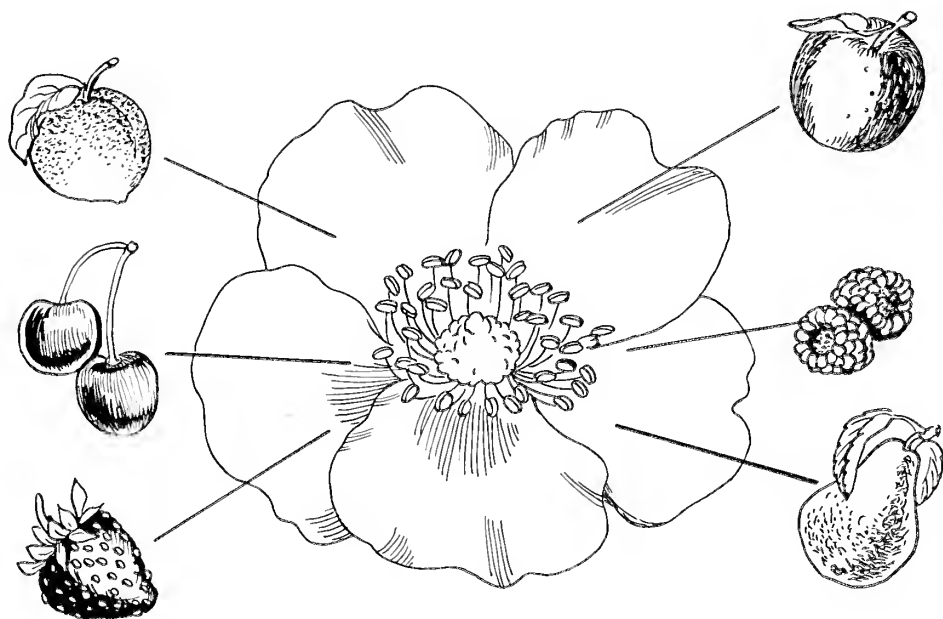
The Fourth Year. The vine should be pruned as a bearing vine.

For commercial growers of grapes, instructions contained in Cornell Extension Bulletin 805 are applicable.



Courtesy Cornell Extension Service

Above: Unpruned grape vine. Below: Same vine pruned and trained to Four-arm Kniffin system. One-year prunings amounted to 1.8 pounds; thirty-eight buds were left on



FAMILIES OF GARDEN FRUITS

And some of their purely ornamental members

Donald G. Huttleston

SIMILARITY of common names or of outward appearance does not necessarily indicate relationship of plants. The Cornelian-cherry, for example, bears no relationship to other cherries. It is a dogwood. Real cherries belong to the Rose Family. Family relationships are based on similarities of **structure**, such as arrangement of flower parts, kind and arrangement of leaves, and type of fruit.

There is often discussion over what is a fruit and what is not. The technical and the common usages of the term do not agree. Technically, "fruit" is the name of any structure containing seeds: to all botanists the tomato is a fruit (a berry) but the Supreme Court in 1903 decreed that it is a vegetable!

Here is a list of the fruits mentioned in this issue of **PLANTS & GARDENS**, arranged in their families:

ROSE FAMILY (Rosaceae). A large family distributed over most of the world, containing some of the most valuable ornamental plants as well as fruits. Other members are rose, geum, and spirea.

Apple	Sweet cherry
Crab apple	Sand cherry
Pear	Nanking cherry
Sand pear	Juneberry
Quince	Blackberry
Plum	Dewberry
Beach plum	Red raspberry
Nectarine	Black raspberry
Apricot	Purple raspberry
Peach	Boysenberry
Sour cherry	Strawberry

RUE FAMILY (Rutaceae). A large family of tropical and warm temperate regions, containing many ornamentals.

Orange	Tangelo
Lemon	Tangor
Lime	Kumquat
Grapefruit	Satsuma
Tangerine	Calamondin

WALNUT FAMILY (Juglandaceae). A small family of temperate North America, of some value for timber as well as nuts.

Black walnut	Heartnut
English walnut	Pecan
Butternut	Hickory nut

HONEYSUCKLE FAMILY (Caprifoliaceae). Native to north temperate regions and containing many ornamentals such as honeysuckle and weigela.

Highbush- cranberry	Elderberry
------------------------	------------

SAXIFRAGE FAMILY (Saxifragaceae). A large family of temperate and subarctic regions, including hydrangea and mock-orange.

Currant	Gooseberry
---------	------------

GRAPE FAMILY (Vitaceae). A small family of tropical and warm temperate regions, containing ornamentals such as the Virginia creeper.

Grape

SOAPBERRY FAMILY (Sapindaceae). Small family of tropical and warm temperate regions, with few ornamental species.

Lychee "nuts"

PAPAYA FAMILY (Caricaceae). Very small family of the tropics, containing only one economic species.

Papaya

CASHEW FAMILY (Anacardiaceae). Small, mostly tropical family containing pistachio and sumac.

Mango

CUSTARD-APPLE FAMILY (Annonaceae). Very small, tropical family with few edible fruits.

Papaw

MYRTLE FAMILY (Myrtaceae). Large, tropical family containing *true* myrtle and eucalyptus.

Guava

EBONY FAMILY (Ebenaceae). Small, mostly tropical family containing few economic species.

Persimmon

LAUREL FAMILY (Lauraceae). Large, mostly tropical family containing true laurel (not mountain-laurel) and sassafras.

Avocado

MULBERRY FAMILY (Moraceae). Large, mostly tropical family including mulberry and hops.

Fig

BEECH FAMILY (Fagaceae). Small tropical and north temperate family containing beech and oak.

Chestnut

HAZELNUT FAMILY (Corylaceae). Small family of Northern Hemisphere, containing birch and alder.

Filbert and hazelnut

HEATH FAMILY (Ericaceae). Large family of wide distribution, containing mountain-laurel, cranberry, and rhododendron.

Blueberry

BUCKWHEAT FAMILY (Polygonaceae). Small family of cold and warm regions, containing few ornamentals, many weeds, and buckwheat.

Rhubarb

RHUBARB

Although really a vegetable, rhubarb (or pieplant) is used like a fruit for pie and sauce. It is most useful from late April until strawberries begin in June.

A rich soil with plenty of manure and fertilizer is essential for heavy crops. VALENTINE, RUBY, and MACDONALD are good varieties.

NUT TREES

Kinds and culture for the home garden in the Northeast

L. H. MacDaniels

IN the northeastern United States there are probably more kinds of nut trees growing wild in the fields and woods than in any other part of the country. Chestnuts, black walnuts, hazelnuts, butternuts, acorns, and three or four kinds of hickory played a large part in the food supply of the early settlers. Through the years good types from these native nut trees have been selected and propagated;

these, with other species introduced, give the Northeast a rather wide selection of nut trees. In the early days the native chestnut was of greater importance than any other nut tree, and its loss (because of the ravages of the blight) has not been compensated by the introduction of oriental species.

In spite of this goodly heritage of nut trees, the Northeast has not developed any commercial nut industry. There is, however, good opportunity for raising nut trees in the home garden and on farmsteads; there they not only serve as shade trees but in many instances add to the food supply and give one the satisfaction of raising something edible on the home place. If some attention is given to adaptability to climate, there is reasonable assurance that a supply of edible nuts can be secured. In most areas in the Northeast (except northern New England and the northernmost parts of New York and Pennsylvania, where the growing season is short) a number of trees can be counted on to mature a crop of nuts. Except for the butternut, a growing season of about 150 days without frost is essential.

Kinds

The black walnut (all things considered) is the most desirable of the nut trees for home planting in areas that have about 160 frost-free days. The trees grow rapidly, come into bearing after five or six years (which is relatively early, compared with hickories), and furnish abundant crops of nuts of good cracking quality. The tree is particularly desirable in some situations, in that its shade is not dense and hence permits the growth of a good stand of grass underneath. It has the disadvantages of coming into leaf relatively late, producing some litter on the lawn, and under some conditions having an adverse effect upon certain garden crops, particularly toma-

Sturdy trunk and main branches of black walnut

McFarland



toes. The trees undoubtedly should not be planted unless the nuts are to be harvested. Varieties available for northern planting are THOMAS and SNYDER. A considerable number of varieties have been selected which are favorable for planting in regions of longer seasons.

The **Persian walnut** (or the Carpathian strain of the English walnut) has promise for growing in milder parts of the Northeast. The trees grow rapidly and are winter hardy, and a number of promising varieties are now available. The new foliage is sometimes injured by late spring frosts, which may reduce the current season's crop. The trees require a well drained, neutral or alkaline soil, and respond rapidly to fertilization. They make a dense shade.

The **butternut** is the hardiest of all nut trees and grows well in northern New England. The trees are somewhat short-lived and apparently do better on black walnut stocks. The nuts are relatively hard to crack but are high-flavored and highly prized where they are known. Named varieties, such as CRAXEZY, JOHNSON, and others, are much superior to the common run of wild seedlings; their kernels come out in practically unbroken halves. As a shade tree the butternut is less valuable than some others.

The **Japanese walnut** (or Japanese butternut, or Siebold walnut) is a vigorous, rapidly growing tree with very large leaves of tropical appearance. Nuts of the seedlings are hard to crack and are not valuable. A bud sport of this type of tree, however, the so-called heartnut, cracks very easily and is often a prolific producer. WALTERS, FODERMAIER, and others are much superior to ordinary seedling types. The tree requires a considerable amount of room and makes shade too dense for a lawn.

Hickory. Of the many kinds of hickories, some of the named varieties of the shagbark are most suitable for the Northeast. When well established, the hickories are among the most desirable of all the nut trees for this area. They make excellent shade trees where fairly large



Roche

Black walnuts in husks on the tree

Butternuts still in husks on the tree

Elsie M. Kittredge





Branch of shagbark hickory, as husks fall from nuts

Elsie M. Kittredge

trees are desired. They are, however, somewhat difficult to transplant and to propagate. For this reason the trees are expensive and are slow in coming into bearing. If one likes good, highly flavored nuts, however, the hickory is the best of all the northern nuts and is well worth waiting for. Once established the trees grow rapidly. For northern planting WILCOX and DAVIS are superior sorts, and GLOVER and WESCHCKE are also promising. Named varieties have not been tried over sufficient area to establish which ones are the best. Various hybrid varieties of hickories have been introduced from time to time, but for the most part these are not worth considering as far as the nuts are concerned. The hybrid pecan BURLINGTON makes an excellent, rapidly growing shade tree.

Chestnut. A considerable amount of progress has been made in growing chestnuts of the oriental species to replace the American type destroyed by the blight. The Chinese chestnut is the most promising of these. The nuts [illustrated in the color section] are of good size and are equal in flavor to the American. The trees grow as large as medium-size apple trees and are highly desirable where they succeed. These Chinese types are resistant to the blight but not immune. Se-

lected seedlings would probably be best for home planting. It is advisable to have more than one tree in any one planting because cross-pollination is necessary for many varieties. Some of the selected varieties are MEILING, KULING, NANKING, and ABUNDANCE. Grafted trees may show stock difficulties and are not generally recommended. Chestnuts require a well drained, somewhat acid soil.

Filberts and hazelnuts have been improved recently through breeding. The trees may be grown either as large shrubs with multiple trunks or as small single-trunk trees. It is difficult, with some varieties, to keep the suckers about the base of the tree from destroying the single-trunk conformation. The trees are not difficult to grow and usually begin bearing three or four years after planting. They need cross-pollination, and so it is necessary to have two or more varieties growing together. Varieties with hardy catkins, such as COSFORD, MEDIUM LONG, and ITALIAN RED should be used.

Culture

Nut trees usually grow very well once they become established. The site should be well drained for practically all kinds of northern nuts. If the soil is heavy, it should be modified with organic mat-

Chinese chest-
nut with burs.
On lower branch
at right, open
bur with its
three nuts

McFarland



ter. Nut trees are more difficult to transplant than such trees as apples and other fruits, and need special care both in planting and in watering immediately afterward. An attempt should be made to conserve as many of the fibrous roots as possible. The soil should be tamped tightly about the trees when they are planted; and for the first year or two, care should be given to the water supply and to cultivation to keep down weeds. Mulching nut trees is a very good practice if they are in a location where this is possible. Anything that will keep down the grass and add to the organic matter of the soil is an advantage, for example lawn clippings, old hay, or strawy manure.

Most kinds of nut trees respond well either to cultivation or to mulching, and to fertilization. Walnuts, particularly, are heavy feeders and respond to fertilizers. If manure is available, it may be used; otherwise a commercial fertilizer high in nitrogen is satisfactory. A fertilizer of 5-10-5 formula may be applied to the surface of the soil under the spread of the branches at the rate of about $\frac{1}{2}$ pound to every inch in diameter of the tree. Usually if a tree does not have sufficient fertilizer, the leaves show a yellow cast indicating a lack of nitrogen.

Harvesting and Pests

Harvesting the nuts is not difficult. Black walnuts should be picked up and the shucks removed before these turn black; they should then be dried where they will not mold. The other kinds of nuts do not require husking as they fall free from the husks. Hazelnuts may be an exception. The chief competitors in the harvest are squirrels and bluejays, which take a toll of any kind of nut.

Pests and diseases are no more troublesome with nut trees than with other sorts, although there are numerous diseases and insects that affect nut trees. It is rarely possible for the home gardener to spray nut trees, because of their size. In most cases, however, a substantial crop will come through without spraying.

Anyone planting nut trees should realize that he is something of an experimenter and that the adaptability of different varieties to various climatic and soil conditions is not known in the same way as for some of the commercial fruits. Nut growing makes a very good hobby if space permits the planting of a number of trees. Certainly nut trees are good wherever shade trees are desired, and thus they have a very real place on the home grounds.

FRUITS OF MINOR IMPORTANCE

For interest and variety

George L. Slate

IN addition to the commonly grown fruits of the Temperate Zone there are a number that are occasionally grown or

harvested from wild plants. Although these are of minor economic importance they add variety and interest to the diet. Selected wild types of some are available from nurseries, and others have been improved by the plant breeder.



The common quince
(*Cydonia oblonga*)

McFarland

Foreign

The **common quince** (*Cydonia oblonga*) is now rarely grown, but old unpared-for baskets are often seen around farm houses. The large golden fruits are not edible raw but make delicious jelly and conserve. They are grown like the other fruits, but because of their susceptibility to fire blight they should be grown in sod after the first two or three years, and over-vigorous growth should be avoided. **ORANGE** is a good variety.

The **Nanking cherry**, or Manchu cherry (*Prunus tomentosa*) yields bright red cherries about half the size of the **MONTMORENCY** cherry and of a pleasant refreshing flavor. The tree grows about 8 feet high and somewhat broader and is one of the first of the cherries to bloom in the spring. More than one clone should be planted, for cross-pollination.

American

The **beach plum** (*Prunus maritima*) is a native of the sand dunes of the Atlantic Coast from New Brunswick to the Carolinas, with a heavy concentration on Cape Cod and Long Island, where it is highly esteemed for making jelly. The plant is a shrub or small tree from 4 to 10 feet in height, completely covered with flowers when in bloom. The fruit is usually dark purple, with a thick tough acid skin and rather harsh flavor. Selections of superior types have been made by interested persons. For seashore locations it is well worth planting.

The **sand cherry** (*Prunus besseyi*), frequently sold by nurseries as Hansen's bush cherry, is a spreading shrub from 3 to 4 feet high, native to the Great Plains; its great resistance to drought, summer heat, and winter cold has made it useful in its native region, where few other fruits can be grown. The fruit is purplish black and usually bitter and astringent; but in selected plants it is sweet and is palatable to people who are not able to grow the better fruits of regions with milder climates. Its poor quality and its susceptibility to brown rot in the humid East make it undesirable there.



Fruiting branch of papaw (P. 204)

Garrettson persimmons, ripe in October (P. 204)

Courtesy N. Y. Agricultural Experiment Station



Selections by fruit breeders are available from Great Plains nurseries, and these are superior to the wild types.

The **dwarf Juneberry** or **serviceberry** (*Amelanchier* species), another Great Plains native, bears a superficial resemblance to the blueberry, for which it is a substitute in its native home. The plant is a low shrub which bears heavy crops of mild-flavored, rather insipid berries. It grows well in the East, but the birds usually harvest the crop. **SUCCESS** is a selected variety.

The **American elderberry** (*Sambucus canadensis*), long popular for the making of pie and homemade wine, has yielded one improved variety, **ADAMS**, which is somewhat larger in berry and cluster than the wild types. It should be planted near wild types for cross-pollination. Although it is commonly found in moist places, it grows well on dry sites.

The **common persimmon** (*Diospyros virginiana*) grows commonly throughout the South, extending well up into Pennsylvania. Seedling trees into which a number of varieties have been grafted are growing well in the writer's garden. Only early varieties ripen their fruit as far north as Geneva. **GARRETTSON**, **EARLY**

GOLDEN, and **JOSEPHINE** ripen in October and November. The trees are easy to grow; but they should be planted while small, as the long taproot does not make for easy transplanting. They often grow on poor eroded soils but are not averse to high fertility.

The **papaw** (*Asimina triloba*), sometimes called Indiana banana, grows wild on rich bottomlands in the region where the persimmon is native, but it is winter-hardy to Lake Ontario at least. The large long glossy leaves give the plant a tropical appearance. The fruits are 4 to 6 inches long, with a yellowish skin and edible pulp in which are numerous seeds about the size of lima beans. The flavor is rich and perfumed; some like it and some do not. The papaw is an interesting plant wholly unlike the other northern trees in flower and fruit; it is about as large as a peach tree.

The **highbush-cranberry** or American cranberry-bush (*Viburnum trilobum*), another hardy northerner, is used for jelly and preserves in cold regions where other fruits are scarce. The plant makes a large shrub and bears heavy crops of bright red fruits which hang well into the winter and are very ornamental.

BOYSENBERRIES

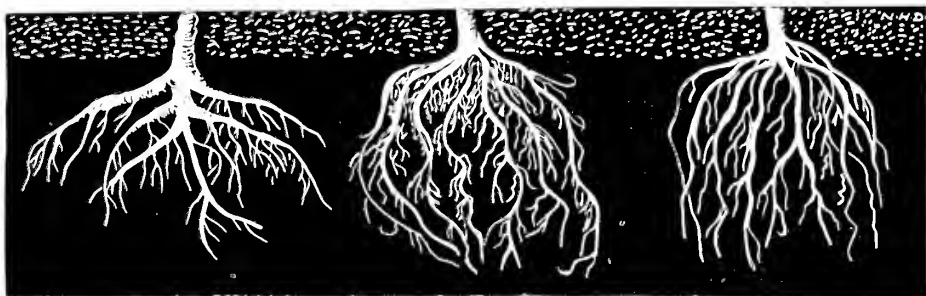
A very large, dark red, high-quality trailing blackberry, known as boysenberry, is grown on the West Coast and south of Washington, D. C. The plants are not fully hardy north of Washington, and should be winter-protected with

straw or earth. In the colder parts of the North they may not produce well even when protected. The trailing vines should be tied to a trellis to keep the fruit clean.

MORE INFORMATION

The United States Department of Agriculture and many experiment stations publish bulletins on various phases of fruit growing. The home gardener can make good use of these bulletins. The county farm bureaus, often located in the court house or post office, can supply

advice on local fruit growing. Instructions for the control of insects and diseases change frequently as new materials and information appear, and the farm bureaus are well informed on the latest control measures.



SOILS AND FERTILIZERS

How to manage them to the best advantage in the home fruit garden

Damon Boynton

PERENNIAL fruit plants have the same general soil requirements as annual garden crops—good aeration, available moisture, and the presence of all essential nutrients in satisfactory quantity. Because their root systems must persist throughout the year over a period of years, soil aeration is particularly important—more so than for annual garden crops. Since they root deeply and extensively in well aerated soils, these plants are able to be productive under conditions of lower soil fertility and moisture than many annual crops. Different kinds of fruit plants have different soil problems and adaptations, however, and so it is worth while to consider their soil requirements and tolerances separately.

Soil Aeration

Need. Sweet and sour cherry, peach, and the brambles are extremely sensitive to poor aeration and should be planted only in soils that are very well drained. The European plum, pear, quince, apple, grape, currant, gooseberry, and strawberry do better on well drained soils than otherwise; but if special provisions are made for them, they may be

fairly productive on soils that are not ideally drained. The highbush blueberry, even though it is thought of as a swamp plant, should have a foot of light, well drained soil for its limited root system to explore.

Signs. If the home garden plot can be plowed early in the spring in wet years as well as in dry ones, it is suitable, in terms of aeration, for any kind of fruit plant. If, on the other hand, preparation of the soil for garden planting has to be delayed because of wetness in some years, this is an indication that peach, cherry, and brambles may not be long-lived there. In judging the fitness of the plot for other fruits, an examination of the subsoil to a depth of 2 feet is helpful. The two most useful signs of poor aeration in the subsoil are (1) grayness or mottled gray and rust color, and (2) abrupt change from relatively light texture to relatively heavy texture. Often these two indications appear together, but not always. Garden locations that are level or depressed in topography and are surrounded by higher land are more apt to be poorly drained than sites that are somewhat sloping, but this is not always the case. In situations in which there is marked mottling of the subsoil or a marked clay layer underlying lighter soil, or in which garden preparation has to be delayed in most years, there is a

real question as to the wisdom of attempting any perennial fruit planting.

Tiling and ridging. Two special provisions helpful in improving the drainage of heavy soils for tree and bush fruits are tiling and ridging. When possible, both of these provisions should be used together. The tile is most effective when placed directly under the rows at a depth of at least 2 feet. Ridging is best done before the trees or bushes are set. The ridges should be built up with a gradual rise toward the row so that no difficulties in culture are created. Depending on the distance between rows, a difference in elevation of a few inches to a foot can be created in this way.

The productivity of **strawberry** beds results to a large extent from the ability of runners to root at the nodes, thus forming daughter plants for the matted row. Heavy soils, which bake into large clods when they dry, furnish a poor rooting medium in many years, and this causes sparse development of daughter plants. Anything that can be done to make the surface granular and friable is helpful in such situations. The incorporation of liberal amounts of compost, strawy manure, or coal ashes in

the soil prior to planting strawberries is particularly useful on heavy soils.

Highbush blueberry root systems are not able to ramify or extend in any but the lightest, most friable soils. Therefore if the texture of the topsoil is heavier than that of a granular loam, sawdust or peat moss should be incorporated with it to a depth of several inches in the area of the blueberry row at the time of planting, and in addition liberal mulching with one of these materials should be practiced.

Available Moisture

Watering. Tree, vine, bramble, and bush fruits on deep, well drained soils are so well able to withstand long periods of drought that they are seldom benefited by artificial watering in the northeastern United States. The length of time that these fruit plants can get along without rainfall on shallow soils depends on the depth of rooting and on the capacity of the soil in the rooting zone to hold available water. Trees on soils underlain with bed rock at 2 feet may respond to watering following two to three weeks without rain in mid-summer. The response is usually in-



Sample of soil well supplied with organic matter and having a loose open structure even when wet



Sample of soil poor in organic matter; its physical condition is such that it cannot be worked when wet

creased size of fruit. If watering is done, it should be thorough, so that the soil under the tree branches is wet to a depth of at least a foot.

Mulching with straw or old hay may be relied upon as a moisture-conservation practice for these fruits. If the mulch is heavy enough to suppress grass and weed growth, it eliminates water competition by those plants and permits the roots of the fruit trees to exploit the moisture in the surface soil. Heavy mulching of this kind is also very effective in preventing run-off of water on sloping locations; it not only diverts much of this water to the subsoil but completely eliminates soil erosion.

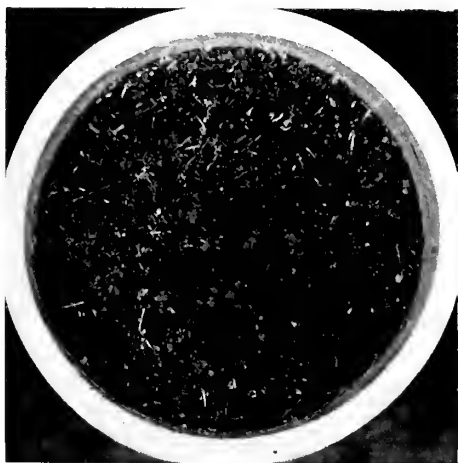
Irrigation. While tree, bush, and vine fruits are not apt to respond to irrigation, in dry weather strawberries frequently do, and blueberries and brambles may. The responses of the strawberry may be of two kinds: (1) increased rooting of daughter plants from runners, and (2) development of more and larger berries from the flower clusters. The former response comes largely as a result of irrigation during the postharvest period from July on. The latter comes as a result of late spring preharvest

irrigation. In either case, when the soil has dried to a depth of 4 to 6 inches there may be response to rain or irrigation. Blueberries under favorable conditions are more resistant to drought than strawberries, but less so than the other fruits because of their restricted root systems. They should be irrigated with soft water if they are irrigated at all, since the lime in hard water may be seriously detrimental to their vigor.

Soil Management and Fertilization

The **supply of nutrients** to perennial fruit plants is determined by (1) the natural supply in the soil, (2) cover crops, decomposing organic materials, and cultivation, and (3) inorganic fertilizer materials. Since nitrogen is the nutrient that is most apt to be available in insufficient quantity, it is the one that most soil management and fertilizer practices are designed to affect first. The two basic soil management practices are permanent sod culture and clean cultivation.

Sod culture can be used most successfully with crops that grow slowly and are tall enough to withstand the competition of grasses for light. The apple,



Sample of soil rich in humus; this soil holds water well without excluding air



Sample of a heavy soil poor in humus; this soil becomes muddy when wet, and splits into clods as it dries

Courtesy Ontario Agricultural College, Dept. Public Relations



Courtesy Ontario Agricultural College, Dept. Public Relations
 Young pear tree in alfalfa sod, with mulch

pear, quince, plum, and sweet cherry fit this pattern best; they can be productive under sod culture over a period of years if some supplemental nitrogen is annually added to the soil in one form or another in the spring. Nonleguminous grass sod is usually as satisfactory as clover or alfalfa sod and is easier to maintain. Fruit trees of these kinds in lawns or bordering them may do very well without any extra fertilization, on account of the nitrogen contribution from the lawn clippings.

Clean cultivation. The peach, sour cherry, grape, brambles, and bush fruits are more vegetative in their growth habits; they are most easily managed under a system of cultivation during the spring and early growing season, followed by a period in midsummer and fall during which a volunteer or planted cover crop will develop. Cover crops may be encouraged between the rows of brambles and bush fruits, but some hand

work is necessary within the rows to keep out perennial grasses and weeds.

The strawberry suffers so severely from competition for light and moisture as a result of grass or weed growth that it is best to keep the bed clean throughout the year.

Mulching. Intermediate between sod and cultivation systems of culture is the practice of surface mulching with decomposing organic materials. This has already been mentioned as a moisture-conservation practice, but it also may contribute available nutrients directly. Cultivation ordinarily cannot be carried out in mulched plantings because the tools are fouled by strawy materials that are usually used as mulches. In plantings of peach and sour cherry the mulching material is concentrated under the trees, and sod develops between them. In vineyard, bramble, and bush fruit plantings the

mulching material may be spread both in the rows and between them. For the strawberry, mulch is used mainly as a winter insulation against cold, and is partly removed each crop season.

The fertility value of mulches varies greatly with the kind of material used and its state of decomposition. Clover and alfalfa hay, manures, and lawn clippings are very high in available nitrogen and produce almost immediate effects when they are used as mulches. Sawdust, on the other hand, is very low in nutrients and has only minor nutrient influences during the first year or two following its use as a mulch. Straw and old hay are intermediate between these two, usually causing some decrease in nitrogen availability but making a substantial potassium contribution at the same time. By the end of a year of decomposition, a heavy straw mulch is starting to contribute available nitrogen, and after three years the soil nitrates may remain high under it throughout the year. This may or may not be a good thing. With peach, sour cherry, and grape the effect is usually satisfactory. Brambles, however, may winterkill seriously as a result of failure to harden for winter under a heavy mulch. Red apple varieties may fail to color well, and pear trees may be excessively subject to blight.

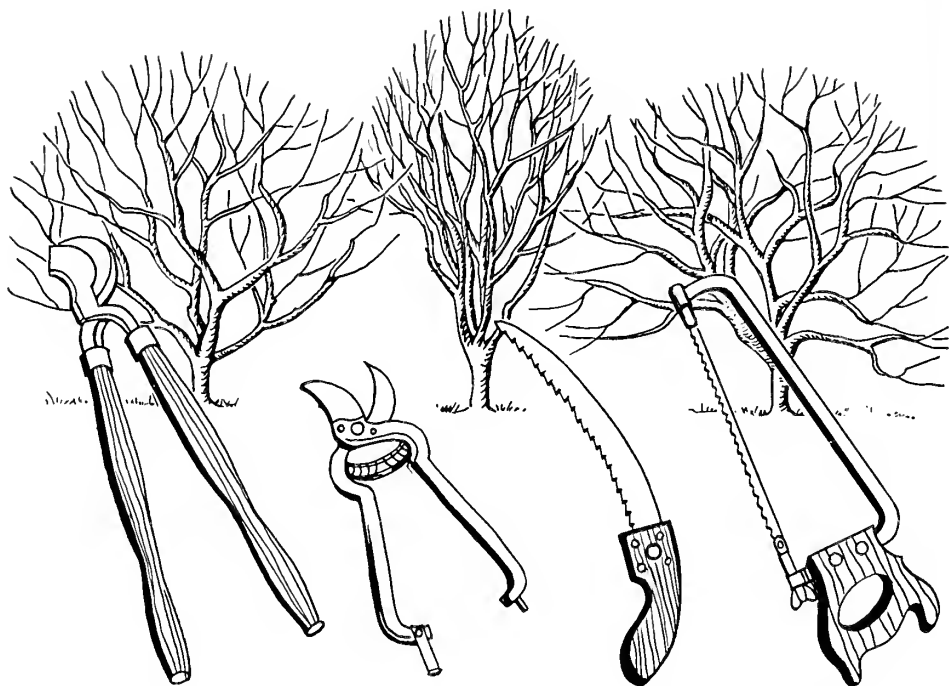
Inorganic fertilizers. While cultivation and mulching may be relied on to furnish part or all of the nitrogen necessary for productive fruit plants in many situations, inorganic nitrogenous fertilizer is needed in many others. How much is needed can best be determined by observation of the behavior of the plants. In general, about 25 pounds per acre of actual nitrogen (the amount in 250 pounds of a 10-10-10 complete fertilizer) is ample for fruit crops on moderately fertile soils under spring cultivation. More is needed on crops under sod and on infertile sites. Less is needed under old mulch and on very fertile sites under cultivation. The nitrogen should be applied in the early spring,

broadcast under the tree branches, or along the sides of the rows. Strawberries should not be side-dressed except on very infertile soils, and the only application of nitrogen to the strawberry should be prior to planting. The nitrogen may be applied in the form of a complete fertilizer containing phosphorus and potash also, or in the form of a salt like ammonium nitrate or sodium nitrate. For blueberries the best nitrogen source is ammonium sulfate, because that leaves a desired residual acidity.

In gardens that have been manured, fruit plants seldom respond to fertilizers other than nitrogen; but if there is any doubt about the amount of potassium or phosphorus present, insurance against deficiencies of these elements is the use of a complete fertilizer. The materials with a 1-1-1 ratio are somewhat preferable to others; the best of them are probably 10-10-10 or 7-7-7. If these are not easily available, a 1-2-1 ratio is all right; the commonest of these is 5-10-5. The rate of application should be determined by the nitrogen needs.

Acidity. All fruit plants except blueberry are rather tolerant of wide variations in soil acidity and alkalinity, but it is best to keep the surface soil in fruit plantings above pH 5.5 and below 6.5. This can be done by liming according to the recommendations of the County Agricultural Extension Service on the basis of soil samples from the garden. It is also possible to estimate lime requirements on the basis of various test kits that are on the market. The main thing to keep in mind is that overliming can create as many troubles as underliming.

The highbush blueberry should be planted only on very acid soil—in the range from pH 4 to 4.5. No lime should be added to the soil under blueberries. Judicious use of flowers of sulfur on soils whose pH is above 5.0 may help to make these satisfactory for blueberries, provided they are also friable or have been heavily mulched with sawdust.



PRUNING FRUIT TREES

Aims and methods for the home garden

L. H. MacDaniels

PRUNING is probably one of the least understood horticultural practices in the garden. This is because it is very difficult to obtain conclusive experimental evidence on pruning practice. The fact seems to be that fruit trees will tolerate a wide range of degrees of pruning without showing any great differences in yield.

Purposes and Results

Basically, pruning consists in removing part or parts of the plant to modify its growth or to make it more fruitful or attractive. It is essentially a dwarfing process, because if parts of a plant are removed the resulting plant will be smaller. On the other hand pruning in-

vigorates the parts of the plant that remain.

In general, the more fruit trees are pruned while they are young the longer fruiting will be delayed. On the other hand, if trees are not pruned at all while they are young, their growth becomes dense, the branches die in their centers, and they become unsightly. Also, trees that are not pruned may develop faulty structure and break under the stress of storms or loads of fruit. Pruning thus varies according to the age of the plants concerned and the purposes for which they are grown. Before bearing age, pruning practice is directed toward training the tree to form strong scaffold branches and to distribute the bearing surface. As the trees get older they must be thinned out to remove the weak growth and must be restrained to keep them in the place that is planned for them.

Time to Prune

The pruning of fruit trees is best done during the dormant season, preferably after the coldest weather of winter is over. Fall pruning may result in increased winter damage about the cuts that are made. Summer pruning, done at the time when the bark slips, is likely to cause damage by tearing the bark of the tree. Also, in the summer the adjustment of leaf surface for the year has been made, and any cutting that is done removes the functioning leaf surface and the fruits that are already set. Pruning of fruit trees in the summer is therefore usually avoided, except possibly for the removal of sucker growth and other growth obviously interfering with the main structure and bearing surface of the tree.

Pruning Tools

One reason why a poor job of pruning is often done is that the gardener has no suitable tools. For the home garden a well designed pair of pruning shears with a fairly thin blade of good steel is essential. A swivel saw or a small curved saw is useful, and if large cuts are to be made, one of the speed saws is an advantage. Long-handled lopping shears do not make clean cuts and thus are not altogether desirable for the more permanent trees like apples and pears. They are, however, extensively used in pruning peaches.

How to Make Cuts

The question "how to prune" divides itself into two problems: how to make cuts and what to remove. The first problem is relatively easy in that what is done can be described in a way that can be understood. If pruning involves the removal of the entire branch back to its connection with the trunk or the major scaffold limbs, the cut should be made so that the resulting wound does not leave a stub, or shoulder, that is difficult to heal over. Small limbs up to 2 inches in diameter can usually be cut off without danger of having the bark

split at the branch base. With larger limbs it is good practice to double-cut, that is cut off the branch a foot or 18 inches from its base to remove the weight, and then cut again close to the trunk or main limb. Another method of removing large branches is first to cut the branch a third or half of the way through from underneath, an inch or so farther out than where the final cut is to be made. The final cut is made by starting the saw close to the trunk on the upper side of the branch and bringing it down nearly parallel with the trunk or large limb. This is shown in the diagrams on the next page.

Meanings of Terms

In pruning, certain terms have definite meanings. "**Heading back**" refers to cutting off part of a straight shoot without regard to side branches. This type of cutting is rarely used in pruning fruit trees, except possibly peaches. "**Thinning back**" refers to removing the terminal part of a shoot or branch system, making the cut just above a branch. Thinning back is in common use. "**Thinning out**" involves cutting out small branches so as to prevent crowding of the remaining growth. Such pruning is done on all fruits.

What to Remove

As to just what should be removed from a growing fruit tree, there is opportunity for disagreement, especially when the fine points are considered. In the pruning of dwarf trees, particularly, a complex system of terminology has grown up which is not within the scope of this article. From the viewpoint of the home gardener, for the most part the fine points of pruning do not make enough difference to deserve consideration. The following suggestions may be considered practical for the home gardener.

The most important consideration in pruning young trees is to build a strong trunk and system of scaffold branches. The method of accomplishing this can

be reduced to several practical directions. 1. Trim the main trunk or leader so that it is longer than any side limb. 2. Avoid narrow angles between trunk and side branches: usually less than 45° between the trunk and a main branch is undesirable. 3. Space side branches vertically well apart on the trunk.

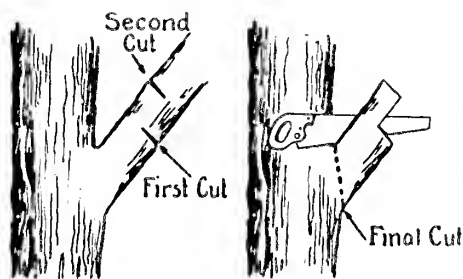
A **trunk** that is divided into two equal branches is fundamentally weak. This condition can be remedied in small trees by cutting off one of the two branches. Removing half of a larger tree may be too severe, however. The condition there can be corrected by cutting small branches from one half of the tree—thus dwarfing it. This is employing a well known principle of pruning, namely that the size of any branch or part of a tree is determined by the amount of leaf surface it carries. The part of the tree that is not pruned will grow larger than the one that is cut back, and will assume leadership. Then the dwarfed branch can be removed. In other words, in starting the young tree a definite leader should be established, and every branch coming from this leader should be smaller in diameter than the main trunk.

Avoiding narrow angles in the main branches is difficult to achieve. By far the best way is to remove the branch forming the narrow angle while it is small. Sometimes it is possible to widen the angle by hanging weights on a branch; this, however, is hardly practi-

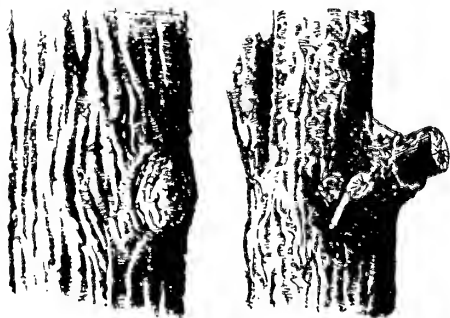
cal. Narrow angles that result in bark inclusions are always weak and serve as an entry for fungus diseases.

In **spacing the branches** on a tree, the gardener must visualize what will happen as the diameter of the tree and branches increases with growth. Spacing branches 3 or 4 inches up and down the trunk may seem a considerable distance while the tree is an inch in diameter. However, when the tree is older these branches will appear to come out at practically the same place. A good rule to follow is to space all branches a foot or more apart, and never to have two come from the trunk at the same level. As trees become older, the pattern of the scaffold branches becomes fixed and cannot be easily corrected. If weaknesses develop, the only thing to do is to brace the limbs to prevent breakage.

In **older trees**, the pruning needed depends a good deal on how much space there is for the tree to occupy. Until the tree becomes taller than is wanted, good rules to follow are: 1. Remove branches which tend to cross from one side of the tree to the other. 2. Remove weak or shaded growth on the inside of the tree. When the tree approaches the maximum size wanted, cutting back in the top is sometimes necessary. It is well to anticipate this lowering of the tree by several years and begin pruning early rather than waiting until the tree is already too tall.



How to remove large branches; double-cutting, cutting from below, and final cut



Courtesy American Fruit Grower

Left: A clean cut close to the trunk, healing smoothly. Right: a projecting stub, difficult to heal over

This usually involves removing branches that are extending outward, cutting them off where they join the larger branches. Shearing off the ends of the branches is usually of little value.

Individual Fruits

Much of what has been written above applies in a general way to all the different tree fruits, with the possible exception of the peach and the quince.

In pruning **apple** trees, the chief objective is to build a strong framework while the tree is young without cutting more than is necessary. When the tree is set out a good practice is to leave the strongest branch as a leader and have one or two side branches. A third side branch can be developed later as the tree becomes taller. When the tree is in bearing, thinning out may be practiced to remove crowded growth. Dwarf trees not trained to special forms require the same training as regards scaffold building as standards.

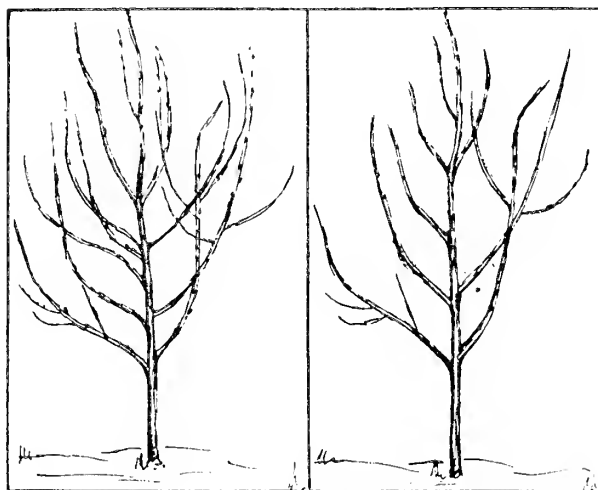
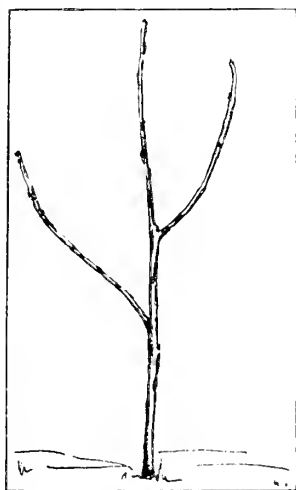
Pear trees are customarily pruned very little in the northeastern states because of the danger of fire blight, attacking overvigorous growth. Corrective pruning to build a scaffold and very

light thinning out are all that is advised for pears. In situations where blight is not a problem, heavier cutting might be an advantage, particularly to thin out the trees for spraying.

Plum trees can be trained after the same pattern as apples and can be cut more heavily than pears. The plum is naturally a small tree and usually is not headed back severely.

Cherries. The **sweet** cherry naturally forms a tree with a strong central leader. This type of tree is satisfactory for the home garden, and usually a sweet cherry requires very little pruning except to remove branches that are shaded and to correct crotch structure. **Sour** cherries need somewhat different treatment; they should be treated the same as apple trees while they are young. Later, after the scaffold is formed, they require very little pruning except to thin out the weaker, shaded wood. As the trees get older, probably replacing them is as satisfactory as any other practice. Thinning out the tops is an advantage to facilitate spraying and to keep the growth vigorous.

Peaches are a special problem. The trees are short-lived and in general make



Courtesy American Fruit Grower

Young apple tree newly set

Two-year-old apple tree, before and after thinning out



Courtesy Minnesota Agricultural Extension Service

Young tree showing one branch (1) with desirable wide angle, another (2) with undesirable narrow angle (P. 212)

much more growth than is needed for the production of satisfactory crops. When a peach tree is set out it is cut to a single whip without side branches. As the lateral buds start in the spring, it is good practice to rub off all but two or three well spaced lateral shoots. These will grow to form the head of the tree during the first year. In the Northeast the tree will need little pruning the second year. Farther south, where more rampant growth occurs, the longer shoots can be cut back perhaps

a third of their length. As the trees come into bearing, the pruning is more severe than that for the other fruit trees and consists in thinning out the tops, thinning back the growth that is getting too tall, and heading back the longer shoots. This pruning is a type of thinning intended to keep the tree low and the growth vigorous. Commercially, orchards are arbitrarily pruned to such a height that the peaches can be picked from a stepladder or even from the ground. The life of the tree is so short that breakage is not likely to be severe, particularly if the branches are cut back relatively short.

Quinces are usually pruned very little except to thin out the heads of the trees as they become thick. Severe pruning of quinces is to be avoided because the vigorous succulent growth stimulated by it is very susceptible to fire blight.

Wound Dressing

On trees that are pruned carefully from the time they are set out, large wounds are reduced to a minimum. When it is necessary to cut off a large limb, protection by a wound dressing is advisable. Any wound 2 inches or more in circumference should be protected by a tree paint. The ideal tree paint is yet to be devised. The home gardener may use odds and ends of any good paint he may have; darkening the color so that it is inconspicuous is an advantage.

NO FRUIT—WHY?

Fruit trees do not always bear fruit when the planter expects it. Several of the many causes of failure to produce fruit are:

1. The tree is not old enough. The different varieties and the different fruits vary greatly in the age at which they begin bearing.

2. The blossoms are killed or injured by spring frost or severe winter cold.

3. The variety may be self-unfruitful and fail because a suitable pollinating variety is not near.

4. The tree may be in low vigor because of an infertile or otherwise unsuitable soil.

5. Severe pruning may delay fruiting.

6. Insects or diseases may weaken the tree or destroy the fruits before they ripen.

PEST CONTROL IN FRUIT GROWING

*A practical guide for raising
really clean fruit at home*

Ellsworth H. Wheeler

“YOU can eat fruit from my trees and vines with your eyes shut and enjoy it too,” a friend once said to me. He was right: a walk through his little variety orchard and plantings of raspberries, grapes, and strawberries proved it. Everywhere the foliage was a healthy green, unmarked by insect or disease. It was early fall, and my friend pointed with great pride to ripening MCINTOSH apples, HALE HAVEN peaches, and DELAWARE grapes. All were remarkably clean; this home fruit grower had learned to control insects and diseases. He was being amply repaid for his efforts, in pleasurable satisfaction and in fine fruit.

Anyone can grow fine, clean fruit. Elsewhere in this issue are discussions of varieties, fertilization, and proper pruning; but these are not enough. One must know also something about controlling pests—the insects and diseases which can rudely interrupt “harvest dreams.”

The Pests

My friend has learned the importance of thorough and timely spraying or dusting. He knows that apple scab can gain a foothold, especially on his MCINTOSH and CORTLANDS, in the young leaves and fruits as fast as they become exposed. He sprays or dusts these two varieties with a sulfur-ferbam fungicidal mixture every week, beginning when the buds first show green color. Other varieties receive only one application—just before the blossoms open.

Following bloom, the worst enemies are likely to be scab, curculio, codling moth, and apple maggot, on apples; and psylla on pears. Both plums and peaches are attacked by curculio, Japanese beetle,

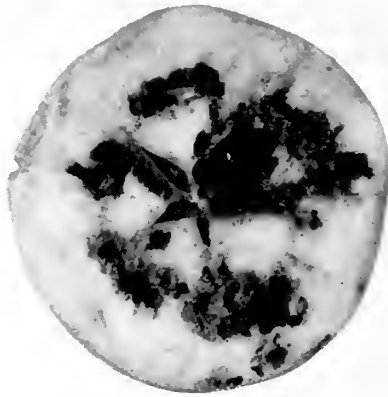
and brown rot. Wormy peaches and quinces are caused by oriental fruit moth. Aphids (or plant lice) may curl the tip leaves on sweet cherries and some apples; curculio and certain maggots and rot may attack any of the cherries. On grapes, rose chafer, Japanese beetle, black rot, and grape berry moth are often serious pests.

That's a rather formidable list, to be sure. But the job doesn't seem so terrible when one understands that not all these pests are on hand at the same time. One can relax a little after the curculio season, which occupies the four weeks following bloom. But Japanese beetle is abundant in July and August; and so are apple maggot, fruit moth, and the rots. The wise gardener realizes this and pays close attention to treatments that are needed fairly late in the growing season.



Courtesy N. Y. Agricultural Experiment Station

Blemishes on outside of DELICIOUS apple,
indicating maggot injury



Courtesy N. Y. Agricultural Experiment Station

WEALTHY apple cut open to show maggot injury

All-purpose Formula

Fortunately some of our newer insecticides and fungicides make it possible to simplify this problem of pest control in the home fruit planting. Very helpful is an all-purpose formula and schedule suggested by the University of Massachusetts. It is easy because the same materials are used in all sprays on all the tree fruits. A slight change is made for grapes and raspberries, and nicotine sulfate may be added when necessary to control plant lice or pear psylla.

The all-purpose formula requires four materials which are now readily available in many hardware stores and most garden-supply stores. They are wettable sulfur (not lime-sulfur), ferbam (Fermate), methoxychlor (Marlate), and DDT. This mixture may be used safely as a spray on all the tree fruits and on ornamental shrubs and garden flowers as well.

Sulfur sometimes injures the foliage of grapes, and has little effect upon diseases of raspberries. When spraying these plants it is preferable to increase the ferbam three times and to omit sulfur.

For each 25 gallons of spray $1\frac{1}{2}$ pounds of wettable sulfur are needed, and $\frac{1}{4}$ pound of ferbam, $\frac{1}{2}$ pound of 50-per cent DDT powder, and $\frac{3}{4}$ pound

of 50-per cent methoxychlor. For just a gallon of spray, 3 tablespoons of sulfur are used, 1 of ferbam, 2 of DDT, and 3 of methoxychlor.

This combination of materials will control all the insects and diseases mentioned earlier except aphids and psylla. That is assuming that the foliage and fruit are thoroughly covered. As my successful fruit-raising friend said, "I found out you can't *miss* 'em and *kill* 'em with the same spray."

Nicotine Sulfate

Whenever any leaf curling is noticed on young trees or on young growth, and aphids are found on those leaves, 2 teaspoons of nicotine sulfate should be added to each gallon of spray. The same should be done whenever there is any blackening of pear leaves or fruit; this blackening is a mold growing in a sticky honeydew produced by the pear psylla. It pays to put the nicotine in at least two successive sprays. It takes a good drenching on a warm, quiet day really to check either aphids or psylla.

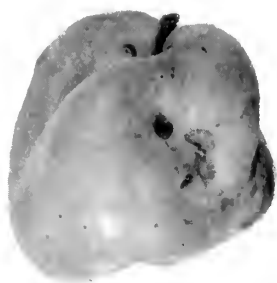
Schedule

Now let's follow the schedule and see how the all-purpose mixture really helps.

Dormant oil. To begin with, it pays to apply a good dormant oil to check scale, mites, and the grape plume moth. The oil need not be used every year on everything, but it helps. It should be put on just as the buds start to swell.

Preblossom spray. We have already told how MCINTOSH and CORTLANDS are handled until they bloom. Everything else is sprayed with the all-purpose mixture just once before the blossoms open. This spray should be applied after the blossom buds have separated but before any blossoms open. Anyone who has a wide variety of tree fruits will probably have to spray some peaches, plums, and cherries before the apples are ready; but this early spraying is not necessary in every planting.

After the blossoming period, all the fruits may be sprayed at the same time. In fact, all spraying may be done on week-ends, beginning with the week-end



Courtesy N. Y. Agricultural Experiment Station

External evidence of damage to DUCHESS apples by plum curculio

when most of the petals have fallen from the apples. Everything is sprayed with the all-purpose mixture, with the omission of sulfur on grapes and raspberries. It is repeated just one week later because this is the critical time for curculio control on plums, peaches, cherries, apples, and pears. Undoubtedly curculio causes more young fruit to drop or become badly blemished than any two or three other pests combined. A third postblossom spray is needed two weeks later, for additional protection against curculio. Grapes or raspberries that are in bloom at any spray time should be left untreated.

The fourth application is less important in any garden that has very little codling moth. However, for anyone who has been finding a considerable number of wormy apples with definite worm holes in them, this postblossom spray (two weeks after the third) is important.

Ripening fruits. The Japanese beetle may start on the raspberries before picking is over. The all-purpose mixture containing DDT should not be used on edible fruits within four weeks of harvest. With the DDT omitted, this interval could be shortened to two weeks. However, on ripening raspberries, peaches, apples, or plums, it is best to make frequent applications of a rotenone dust or spray for protection against this beetle.

For really fine fruit the remainder of the schedule is important. So far, we

have followed through four postblossom sprays. After a two-week interval, a fifth application should be made on everything but cherries; and a sixth on late-ripening peaches and all apples and grapes except the early ones. These sprays are absolutely essential to control the apple maggot, which makes the brown tunnels all through apples, and the oriental fruit moth, which is the cause of wormy peaches and quinces. The sulfur and ferbam help to check rots.

Some home fruit growers go one step farther on late-ripening varieties of apples and grapes. They are well repaid by a seventh postblossom application to these varieties, to stop late berry moth and apple maggot.

In this story of pest control in the home fruit planting, we have made no attempt to supply detailed descriptions, life histories, and specific control measures for the many insects and diseases which blemish or destroy our fruit. These details are available elsewhere.¹ It has been our purpose to provide a practicable guide to materials and an application schedule designed for the home fruit plantings. The schedule cannot be shortened, for pests—like taxes—are always with us. Anyone who carries the project through—really through—may reap a harvest of fine fruit and of pride in his accomplishment.

¹ Some of them in PLANTS & GARDENS, Autumn, 1950, page 186.

FRUITS

TROPICAL AND SUBTROPICAL

For home gardens

H. S. Wolfe

THE only truly tropical area in the United States—one that never experiences frost—is on the Florida Keys. Many typical fruits of the tropics are grown, however, in the southern part of the Florida peninsula, especially near the coast from Palm Beach and St. Petersburg southward. The area suited to subtropical fruits is much more extensive, reaching its northern limits

Fruiting branch of kumquat

McFarland



along the Atlantic Coast in Virginia and extending southward along the coastal plain to southern Texas, then leaping across to southern California and adjacent Arizona. Not all of this area is equally suited to all fruits. Some thrive only in the warmer half of this area, while others flourish in the cooler part.

Citrus Fruits

Kinds. Best-known and most important commercially among subtropical fruits are the *orange*, *grapefruit*, *lemon*, and *tangerine*. These are suited to the warm subtropics (and to the tropics also), and are chiefly cultivated in central and southern Florida, the Rio Grande valley of Texas, and southern California and Arizona. Lemons are a little less hardy to cold than are the other three; but while their commercial production is largely limited to California, they may be grown for home use in all the areas of citrus culture mentioned here.

Satsumas, *kumquats*, and *calamondins* are citrus fruits able to endure a few degrees more of cold than oranges, and so are grown in northern Florida and southern Alabama, Mississippi, and Louisiana. *Limes*, on the other hand, are tropical fruits and are grown extensively only in southern Florida, with some culture in the warmest parts of California and Texas. The calamondin is essentially an unusually hardy lime and is grown only for home use.

Culture. Citrus trees of all kinds require the same sort of attention to fertilizers and to pesticide application as do northern fruits, but they do not require the care in training and pruning given apples or peaches. Because they are all evergreen and usually make three flushes of growth each year, citrus trees

must be fertilized three times a year.

All citrus fruits, except lemons and limes, have a long period of time during which any individual fruit may be harvested. Usually it is at least three months from the time a given variety reaches good eating maturity until it is definitely overmature. Thus a few fruits may be picked daily over several months. Lemons and limes are picked immature, but their repeated blooming makes their fruit constantly available.

An item of unusual importance with all citrus fruits is the root stock employed. In general the sour orange stock is satisfactory for most citrus fruits on soils of good moisture content, while rough lemon stock is better for well drained sandy soils. There are several cases of special adaptation of scion to stock, however, in which neither of the above stocks is satisfactory. Thus, the satsuma does well only on the trifoliate-orange as stock.

Varieties of *orange* are far fewer than those of apple or peach, although commercial orange production closely rivals that of the apple, and half a dozen varieties make up 95 per cent of production. **VALENCIA** is the leading variety in all the orange-growing states (except for the small Louisiana industry) and matures in spring and summer. **WASHINGTON NAVEL** is the other leading variety in California for fall and winter, while in Florida and Texas several varieties mature in sequence in this period. *Grapefruit* varieties have less variation in maturity; some are seedless, others seedy. **MARSH** is the leading seedless variety, and several pink-fleshed sports are popular. **DUNCAN** is the chief seedy variety and the standard of quality. **DANCY** is the best-known *tangerine*.

Often classed with oranges for convenience are some hybrids between orange and tangerine, the *tangors*. The so-called **TEMPLE** orange is one of these and when well grown is considered unsurpassed in flavor among oranges. Its season is late winter. Another interesting group of hybrids is the *tangelos*, the result of crossing tangerine and grapefruit. Some tan-



GRAPEFRUIT—in a cluster like grapes

BRUNSWICK figs on the branch (P. 220)

Courtesy H. H. Hume





Oriental persimmons (P. 221)

Courtesy Univ. of Florida



Avocados (P. 222)

gelos are like very juicy oranges, while others are rather tart; but all are tasty. Among the best are the midwinter-maturing MINNEOLA and SEMINOLE.

The commercial *lemon* varieties, EUREKA and LISBON, are best for home use in California; MEYER is strictly a home lemon, grown in Florida, Texas, and California; its rind and flesh are orange-colored. The chief *lime* variety of Florida is the PERSIAN (TAHITI), which is green and seedless; this is also the lime of California (known there as BEARSS). Texas and the Florida Keys grow the seedy KEY, or Mexican, lime.

Fig, Kaki, and Lychee

Typical fruits of the cool subtropics are the fig and the kaki, or oriental persimmon, which do best north of the areas of satisfactory citrus culture. Both are deciduous in winter and mature their fruit in summer and fall. For the most part, no pollination is required for fruit setting in the varieties grown for home use. No systematic pruning is practiced in the home orchard.

Figs are troubled greatly by the root-knot nematode, especially on sandy soils,



Cluster of
lychee nuts

Courtesy Univ. of Florida

and must be heavily mulched in the garden to avoid attack. They are propagated only by cuttings. CELESTE, BRUNSWICK, and BROWN TURKEY [illustrated in the color section] are leading varieties in the Southeast, while the latter two plus KADOTA, ADRIATIC, and MISSION are all popular in California.

Oriental persimmons are about like apples in range of fruit size and are bright yellow-orange to orange-red in color. TANENASHI is the chief variety in the Southeast, and HACHIYA in California; both are large and seedless and need no pollination. A few varieties needing pollination are sometimes grown. All kakis are free from astringency when soft and ripe, but most seedless ones pucker the mouth until they are fully ripe. FUYU is an unusual variety which is never

astringent at any stage of maturity. Kakis are grafted on seedling root stocks of several species: in Florida and Texas the native persimmon is used; while in California, seedlings of the kaki and of the Chinese lotus persimmon are preferred. In the South, kakis are usually rather short-lived.

The lychee is a fruit of the warm subtropics which has recently been planted commercially in central and southern Florida. The fruits mature in June and look like large ripe strawberries; they have a brittle red shell around a glistening white pulp of delicious flavor. The tree is propagated only by air layering but is easily grown. The dried fruits, resembling raisins in a thin shell, have long been imported from China as lychee "nuts."



Papaya tree maturing its first fruit (P. 223)

Courtesy Univ. of Florida

Fruiting branch of guava (P. 223)



Avocado

Avocados are derived from three wild races with different climatic adaptations. The Mexican race endures as much cold as the orange, the Guatemalan race is about as hardy as the lemon, and the West Indian race is more like the lime in cold tolerance. Florida grows varieties of the latter two races and of crosses between them, while California grows the first two races and their hybrids. In California it is possible to have fruit maturing every month in the year, while in Florida fruit may be had from June until April or May. Very few varieties are common to both states.

Avocado fruit is rather unusual in having the stored food chiefly in the form of fat rather than sugar or starch. Like citrus fruits, avocados may be left on the tree for weeks after they first become edible, and they never soften on the tree. Indeed, they improve in quality for home use the longer they hang, although there is steady loss in number by droppage. In Florida (if a single tree is planted) there is often failure to set a good crop, for lack of pollination; but this seems to be a less common trouble in California. Avocados are budded or grafted on seedlings and are given neither training nor pruning in any systematic way.

Mango

One of the best tropical fruits is the mango, which may be considered the peach of the tropics; it matures in the summer, like the peach. Many seedling trees have fruit filled with stringy fibers, but the cultivated varieties are as free from fiber as peaches. Like the peach, again, the mango softens on the tree at full maturity and drops, and so picking must be done every few days. Some mango varieties are among the most beautiful fruits in the world, combining red, yellow, and purple, while others are modestly yellow or even green at ripeness. Mango trees are found occasionally in the warmest parts of Texas and California, but their culture in this country is really satisfactory only in southern Florida.



Mango tree in fruit

Courtesy U. S. Dept. of Agriculture

The trees are propagated by budding or grafting and are rarely pruned. Bees are very helpful in pollinating the flowers.

Papaya and Guava

The **papaya** is the most rapidly maturing tropical fruit tree; it is a giant herb with no real woody tissue. The fruit resembles a melon, both in appearance and in taste, and may be from 1 to 15 pounds in weight. About five months from seed the tree begins to produce flowers, and thereafter for many years (unless cold kills it) a flower is developed in the axil of each new leaf. The stem usually does not branch, and so after several years the fruiting area is many feet from the ground. Size of leaves and fruits decreases as the plants grow older and taller, and so it is better to cut down the trees after two or three years and replace them with new seedlings. The first fruit is

usually matured in less than a year from seed. Some varieties have perfect flowers, while other have female flowers and must have a male tree to pollinate them.

The **guava** is a fruit widely cultivated in the tropics, not so much as a dessert fruit as for the jelly which is so easily made from it. There is great variation in guava sizes, and some of the larger types (weighing over half a pound) are fine for canning as guava halves. This fruit is unusually high in vitamin C content, the average value being several times that for oranges, and guava jelly retains much of this. Some guava fruits are usually found maturing from off-season bloom at almost any time of the year, and certain types mature chiefly in winter, but the main season of maturity is late summer. Until recently propagation was chiefly by seed, but air layering is now making propagation of named varieties easy.



Frances M. Miner

The roving gardener, using weed-killer spray along edge of walk

WITHIN THE BROOKLYN BOTANIC GARDEN

The Roving Gardener

The little odd jobs that must be done in a perfectly-cared-for Garden have long been a problem; a happy solution was found this past summer in the appointment of Miss Joan McDavitt as Roving Gardener. But working on the fine points along 2 miles of walks is as much a matter of transportation as of skill and interest on the part of the Roving Gardener. We took our transportation problem to William P. Avery. The answer seems simple enough; it is the "cartcycle" pictured above, which he designed and constructed. The carrier box of the side car has room for two small spray tanks, one of which is currently filled with a general weed-killer solution for edging walks and killing weeds and grass that may grow up through the paving. The other tank contains 2,4-D for special weed-killer use. The carrier also has room for trash and weeds that accumulate as the Roving Gardener makes her rounds. Small tools go in the wire basket, and a bamboo rake fits into clips on top of the frame.

Lily Trials

Two years ago a special lily bed was planted with more than 500 bulbs of some 60 lily species and varieties. The lilies had no special care; they were not even sprayed. The results will be interesting to gardeners in the city, for a half-dozen kinds survived every pest and disease. More about this in a future number.

Guide to the Woody Plants

Curator Emeritus Arthur Harmount Graves is soon to publish a unique guide to the woody plants of the northeastern United States;* it includes trees, shrubs, and woody vines, native, naturalized, and exotic. The book has been planned as a guide which can be carried into the field, and contains simple keys and more than 300 illustrations.

*Illustrated Guide to Trees and Shrubs, with 45 plates and 116 text figures reproduced from pen-and-ink drawings by Maud H. Purdy. About 280 pages, 6 x 9 in., bound in cloth. Available from the author, 255 South Main St., Wallingford, Conn., or through the Brooklyn Botanic Garden, Brooklyn 25, N. Y. Ready in December, 1951.

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TO VISITORS

To reach the Garden:

By Subway: from Manhattan, twenty-five to thirty minutes' ride from Times Square or Grand Central.

I.R.T., West Side (7th Avenue or Broadway-7th Avenue line), downtown express marked "New Lots Avenue" or "Flatbush Avenue," to Eastern Parkway-Brooklyn Museum Station.

I.R.T. East Side (Lexington Avenue line), downtown express marked "New Lots Avenue" or "Utica Avenue" or "Atlantic Avenue," to Nevins Street, step across platform and change to 7th Avenue or Broadway-7th Avenue train, ride to Eastern Parkway-Brooklyn Museum Station.

B.M.T., Brighton Beach line, downtown express or local to Prospect Park Station.

By Automobile:

From Long Island, take Eastern Parkway westward, and turn left at Washington Avenue.

From Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway; follow the Parkway to Washington Avenue, then turn right.

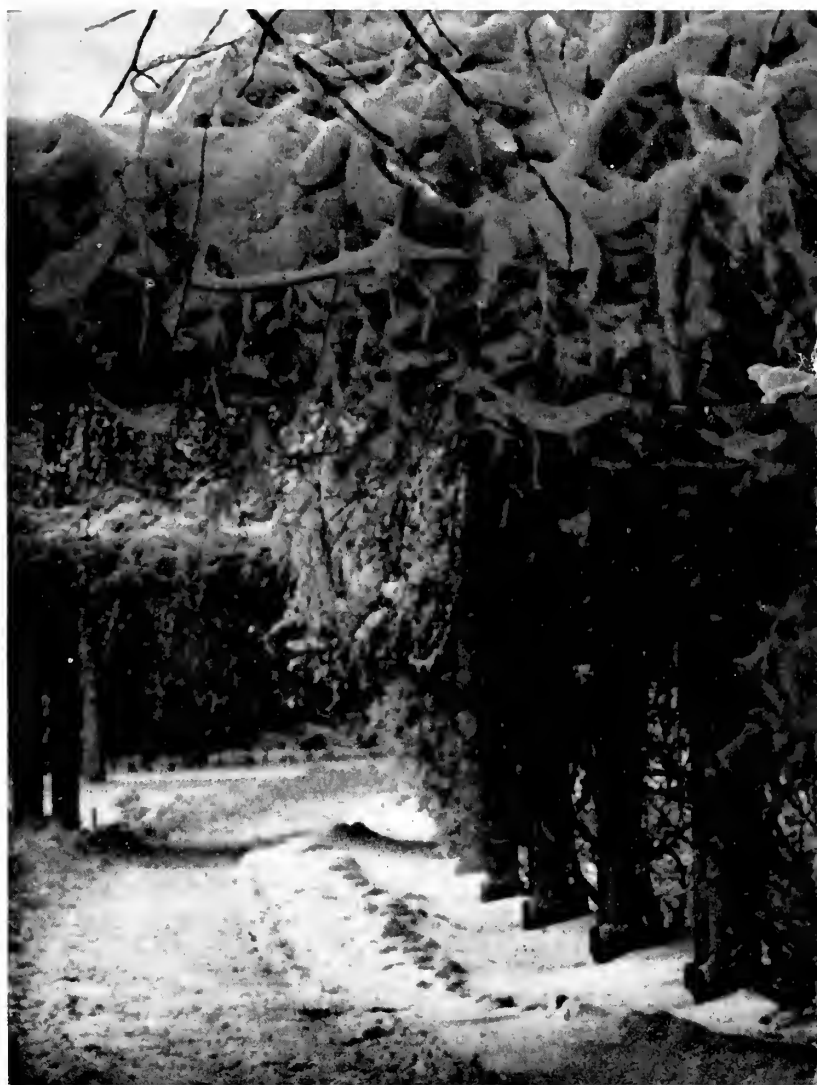
PLANTS & GARDENS

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Year's Highlights
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VOL. 7 NO. 4



AUTHORS WHOSE ARTICLES APPEAR IN THIS ISSUE

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PLANTS & GARDENS

Toringo Crab Apple (*Malus sieboldi arborescens*)

Vol. 7

Winter, 1951

No. 4

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Except where otherwise credited, drawings by MARTIN G. LANGENAU, JR.

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Winter 1951-52

ABOUT THIS ISSUE

Of the several hundred nontechnical articles on gardening and horticulture that have appeared during 1951, the Botanic Garden Editorial Committee has chosen seventeen that in its judgment are of lasting interest; the selected articles are reprinted here in condensed form. Thus the Botanic Garden honors the authors, as well as the publishers of the many different magazines in which these articles first appeared. Without the whole-hearted cooperation of all concerned, this special issue would have been impossible.

Perhaps the most challenging new horticultural method of the year is "How To Move Plants Any Time." Many will want to try this new procedure for more successful transplanting, particularly in off-season work. (See page 232.)

If you are an apartment dweller and have a longing to dig in the earth, there is an idea for you on page 257. You might even like to undertake a conservation project of your own (pages 247-250). Why not start a bit of forest for your children?

Most of us have been told many times about peas and grains of wheat being found in the tombs of ancient Egypt — and that they are still able to sprout. Such reports have been misleading, but now comes what seems to be rather sound evidence of Lotus seeds that will still germinate after a thousand years (p. 268). The best evidence on how long seeds in storage can retain their capacity to grow, must come from actual experiments (p. 271).

How near the North Pole can seed plants live and how many kinds exist in the Arctic? Since the story on Lappland in the summer issue, there have been many questions on this subject. For an authoritative answer, see page 259. Although there are hundreds of kinds of plants in the Far North, the Antarctic continent, where climatic conditions are more rigorous, boasts only three species.

THE SPRING ISSUE for 1952 will feature plant hormones and how they are used in the control of plant growth — from weed killing to the production of seedless fruit.

Sincerely yours,



Director

Please Note:

Title page and contents of the 1951 volume will be sent to libraries for binding and will be available to individuals upon request.

View from Members' Room in Administration Building, Brooklyn Botanic Garden

← Except where otherwise credited, photos by Louis Buhle

TO EDGE YOUR DRIVE AND WALKS

Try these smart ways

Victor H. Ries

Reprinted from *Better Homes & Gardens*
magazine, April, 1951

GETTING the most in good looks from your home setting means making corners and narrow strips pay dividends, bear their fair share in creating the over-all beauty you want.

The location of the buildings on your home site, and its elevation above the street, may have been the big factors in determining the placement of your drive and walks. Several awkward angles and soil strips may be left. But they needn't continue to be unattractive.

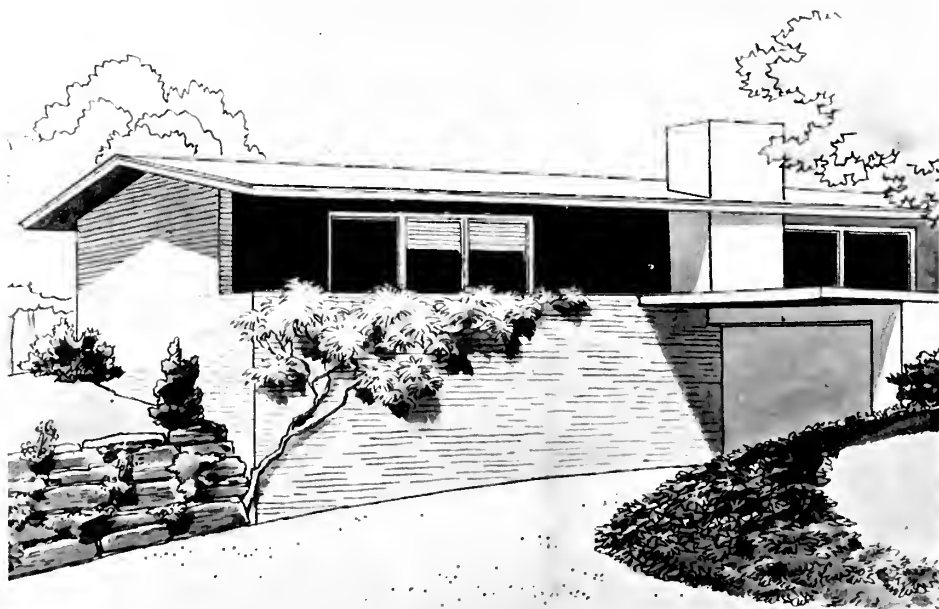
Here's how to improve such strips with handsome plantings that adapt to dozens of situations:

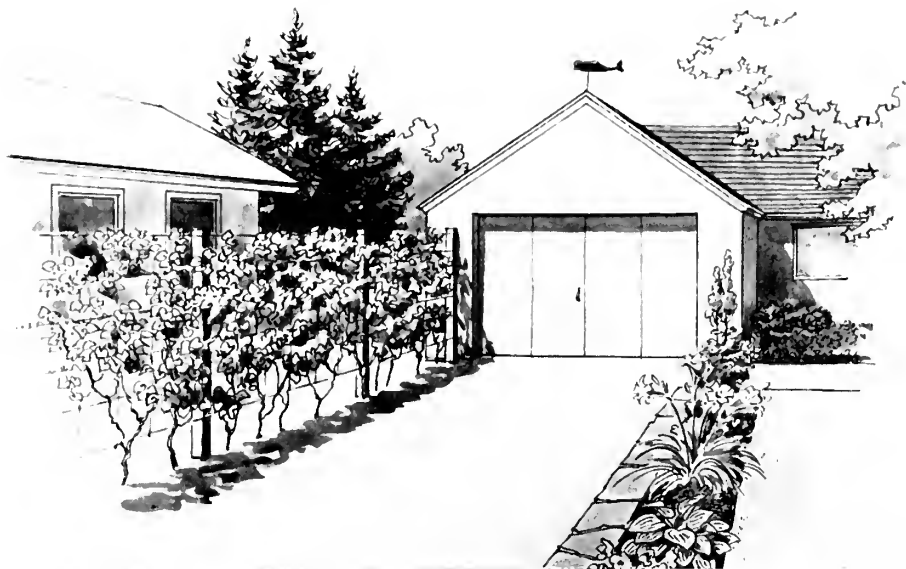
Copyright, 1951, Meredith Publishing Co., Des Moines, Iowa.

Slopes or Banks along Drive

Periwinkle, Japanese spurge, or ivy will cover a bank where grass is hard to grow and mow. Or build a dry wall and fill cracks with rock plants; a vine will root in the wall, and carry across a bald foundation

Harrie Wood drawings, courtesy Better Homes & Gardens





Between Drive and Lawn

An annual or hardy perennial flower border makes a pleasant transition between lawn and drive. For lot-line privacy, try a 6- or 7-foot wire fence covered with wisteria, bittersweet, or climbing roses

Between Drive and Hedge

Eliminate a problem by substituting a ground cover for grass between a hedge and a drive. Try periwinkle, English ivy, or Japanese spurge for evergreen cover





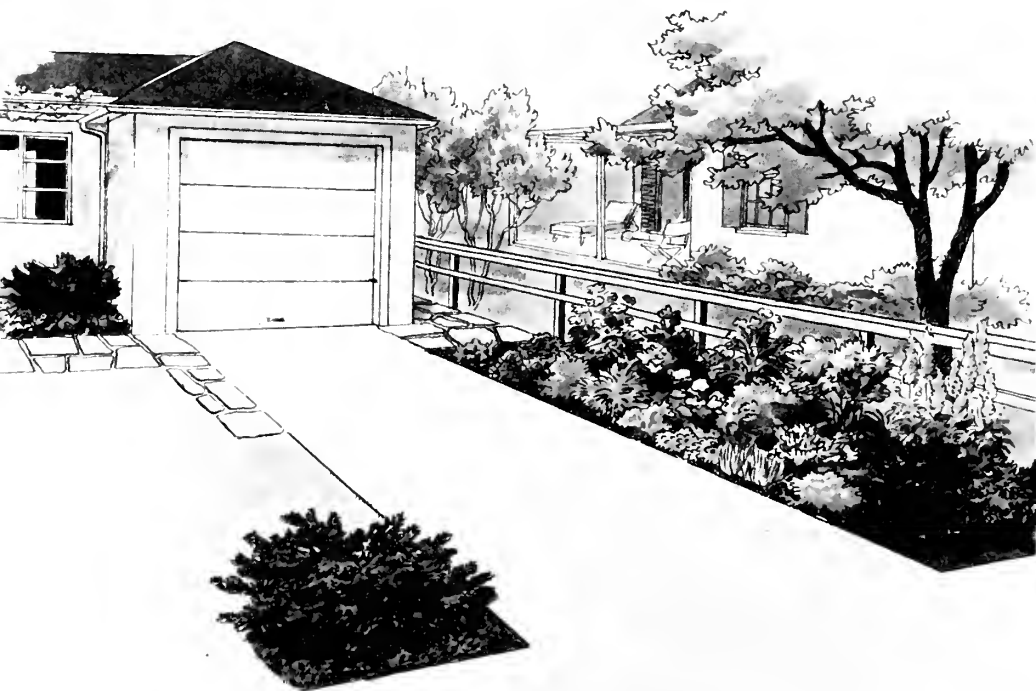
Between Walk and House

Available space determines what you plant. If space is only 2 or 3 feet wide, don't use shrubs which require 5 feet when full grown. Try tulips or spring-flowering bulbs, then geraniums or annual flowers. Or let the vines grow up two or three single strands of wire



Drive Entrance

Tall-growing shrubs or small trees at street intersection are traffic hazards. One should be able to see over mature plants when seated in car. Try Andorra juniper or dwarf Japanese yew



More Plants to Edge Your Drive

NARROW STRIPS IN SUN

Verbenas, smi-roses, cerastium, perennial flax, portulaca, gazanias.

NARROW STRIPS ON THE NORTH

Moonseed-vine, fringed bleeding-heart, meadow geraniums, ferns, columbines, Virginia-bluebells, lance-leaf hosta.

LOW-GROWING ANNUAL FLOWERS FOR BORDERS

Petnias, dwarf marigolds, Mexican zinnias, California-poppy, Salmon Globe amaranth, verbenas, double nasturtiums, sweet-alyssum, calendula.

LOW-GROWING HARDY PERENNIAL FLOWERS FOR BORDERS

Dwarf bleeding-heart, forget-me-not (*Anchusa*), showy stonecrop, Siebold stonecrop, Ellacombe stonecrop, carnations, gaillardia, coreopsis, day-lilies, cushion-type chrysanthemums, daffodils, single early tulips, grape-hyacinths, violas, globe-flower, coral-bells, Carpathian harebell.

CLIMBING ROSES FOR FENCE OR TRELLIS

Mary Wallace, Dr. Van Fleet, Doubletons, Paul's Scarlet, American Pillar, Dr. J. H. Nicolas, New Dawn.

POLYANTHA ROSES FOR HEDGE BETWEEN DRIVE AND LAWN

Pinocchio, Goldilocks, Summer Snow, Betty Prior, Donald Prior, Permanent Wave, Mrs. Finch, Else Poulsen, Improved Lafayette.

LOW-FLOWERING HEDGE ALONG DRIVE

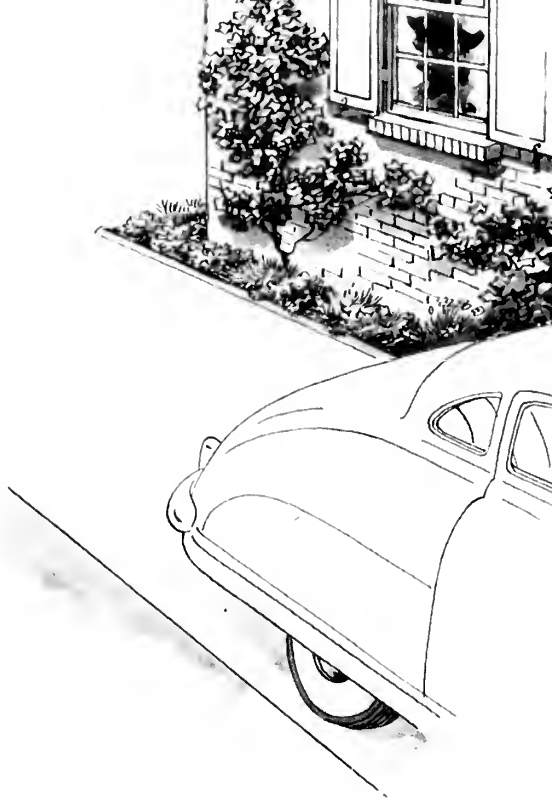
Shrub-althea, glossy abelia, Froebel spirea, slender deutzia, shrubby cinquefoil, gold-drop.

NARROW-GROWING EVERGREENS

Hicks yew, wintergreen barberry, Chénault barberry, three-spine barberry, Douglas arbor-vitae, Camart juniper, Japanese holly.

SMALL TREES FOR SHADE OR SCREEN

Russian-olive, Washington thorn, red-



Between Drive and House

Loosen soil with a fork; lighten it with compost. Plant sedums, Cheddar pinks, annual phlox in sun; Baltic ivy, periwinkle on north

bud, purple-leaf plum, Bechtel flowering crab, mock-oranges.

TALL-GROWING SHRUBS FOR SHADE OR SCREEN

(Pruned to one or two trunks.)

Black-haw, Siebold viburnum, Amur maple, Amur honeysuckle, beauty-bush, wayfaring-tree, nanny-berry, Japanese tree lilac.

After picking the plants you want to grow in your narrow strips, prepare the soil carefully.

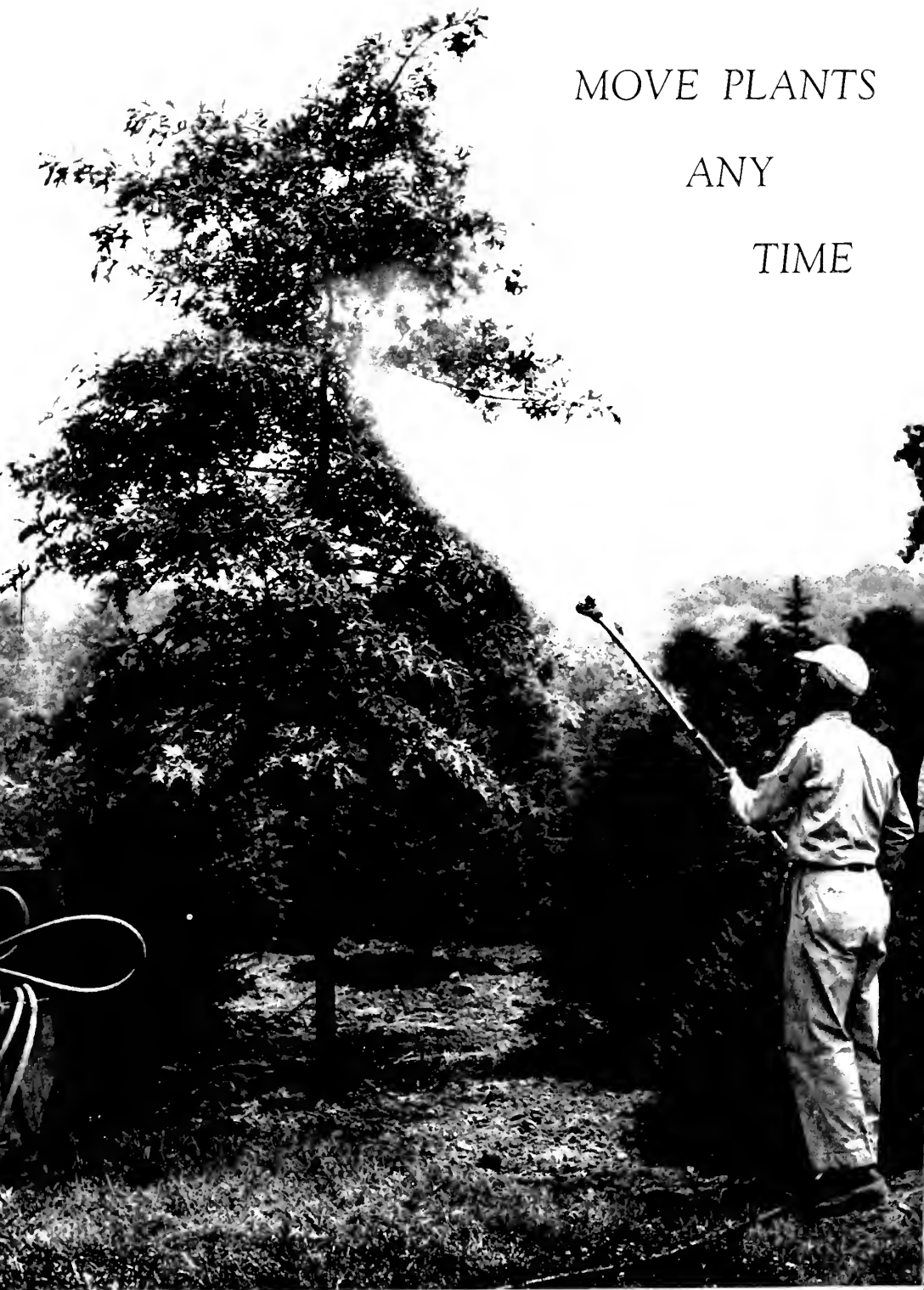
Success will depend on your soil being fertile and free from trash.

If you have a hedge to contend with, better sink a metal strip or asbestos shingles parallel to it, so your new plants get the food and water you give them.

MOVE PLANTS

ANY

TIME



Plastic spray prevents wilting in transplanting

J. W. Johnston

Condensed from *New York Herald Tribune*,
June 24, 1951

THREE years of experimental work on the part of Howard C. Taylor of Rosedale Nurseries at Eastview, New York, resulted in the development of a product that bids fair to revolutionize the whole procedure of nursery handling of plants and be a great boon to the amateur gardener as well.

Through the medium of a plastic latex liquid which is sprayed over the stem and foliage of a plant, the subject is wilt-proofed and may be moved in midsummer with the same degree of safety that dormant plants minus foliage are moved earlier or later in the year.

In the past, transplanting of many varieties of ornamental stock ceased with the approach of summer; and bold was the garden maker who risked moving a tree, shrub, or evergreen after the midspring deadline.

Oaks and Dogwoods

One outstanding illustration of the effectiveness of the new material is the successful transplanting of a 40-foot pin oak in full foliage, a tree not too easy to move in that size at any time.

Many types of plants, ranging from shrubs in flower through evergreens to small trees, all in full leaf, had been dug for five days and left with no additional watering or protection other than the burlap which covered the root ball. Not a wilted leaf was visible and the plants looked as fresh as if they were growing in the nursery rows.

A planting made four days previously included dogwoods as high as 8 feet, laurel, flowering shrubs, and other broad-leaved evergreens, all in perfect shape, though a hot sun was directly upon them.

Method

A gallon of the protective material is placed in 4 gallons of water agitated well and is ready for use in any type of sprayer. The purpose of the wilt-proofing is to eliminate loss of water through the stem and leaves of the plant. A summer-transplanted tree, even though balled and burlapped, would under the old system lose a high percentage of its water-gathering roots, but none of its water-losing leaves.

Sprayed with the Taylor product, the stem and each leaf is coated with a delicate film. Although this film reduces the water loss to the supply of the existent roots, it is porous enough to permit normal breathing of the plant. Three years of use on check plants, to detect any damage, reveal not the slightest ill effects on the plant itself. Plants coated before digging start to grow almost immediately, and before the protective coat wears off they are generally well rooted and thriving.

Many other possible advantages have come to light, and checks are being made to confirm them. When the product is used as a sticker for sprays in control of insect and disease damage, for instance, a much more effective protection is secured and one which lasts longer. When used for this purpose the mixture is one to 10 parts of water rather than the one to 4 used for wilt-proofing.

Evergreens

When used in early winter on plants such as rhododendrons or other broad-leaf evergreens, the browning of foliage common during certain winters through moisture loss is entirely avoided.

Copyright, 1951, New York Tribune, Inc., 230 West 41st St., New York 18, N. Y.

← *Joe Engels photos, courtesy Rosedale Nurseries*
Applying wilt-proofing spray to pin oak in full leaf

Wild Plants

Complete success has been achieved in gathering native material during the summer months simply by spraying the plant with a small portable sprayer before digging. The system works even on plants that are difficult to move at any season. During the spring and fall, when transplanting is easier, the addition of the protective coating eliminates plant loss. It is believed that good results will be obtained by back-yard gardeners with the transplanting of such small plants as annuals and vegetables.



Wilt-proofed dogwood and laurel planted in June. Photographed four days later, they showed no wilting despite hot sun

The Spray

Mr. Taylor, a past president of the American Association of Nurserymen, announces that material will be made available to all who want it, including nurserymen and the small gardener. His wilt-proofing method is a major advance in horticultural science, to be shared by everyone and will result in greater satisfaction for the trade as well as the customer.*

*Mr. Taylor says the material is now being marketed as WILT-PRUF.—Ed.



Philadelphus Minnesota Snowflake in bloom, five days after it was wilt-proofed, dug, and burlapped

FOLIAR FEEDING

*The latest report**

Joseph Kuc

Condensed from *Popular Gardening*, May, 1951

SUPPLYING food to plants through their leaves is a practice tested by scientists and found to be sound, practical, and necessary or desirable under certain conditions.

Lest the dirt-gardener misunderstand and so disapprove of foliar feeding—it is not a substitute for, but in most cases a supplement to, the food taken by plants from the soil—to aid in getting more vigorous growth and greater yields of fruits and flowers.

Grapes

I worked under Dr. Pirone at the New York Botanical Garden and conducted tests on hundreds of plants. Thirty-six Golden Museat grape plants, all rooted from the same parent six months earlier, were set in individual pots containing a potting mixture of 2 parts soil, 1 part leaf mold, and 1 part sand. All were grown in a greenhouse in which the temperature and humidity were carefully controlled. Precautions were taken to prevent any of the nutrient from reaching the soil, so that growth could be established conclusively to be due to the foliar spray. The plants were divided into four lots of nine each. Lot one was sprayed once a week; lot two, three times; and lot three, five times. The check lot, number four, was left unsprayed except for an occasional application of tap water.

*Earlier report in *Plants & Gardens*, Winter, 1950.—Ed.



Photos courtesy New York Botanical Garden

Golden Museat grape vines tested with Ra-Pid-Gro. Check plant (at left) not sprayed; other plants (in order) sprayed once, three times, and five times a week

The difference in vigor and growth between the sprayed and unsprayed plants was clearly visible. Sprayed plants were also a much deeper green. Chemical analyses of the foliage showed that approximately 50 per cent of the nitrogen and 15 per cent of the phosphorus applied to its surface entered the leaf within one hour of spraying.

After nine weeks, plants were removed from pots and further measurements were taken. The sprayed plants showed significant increase in weight of the entire plant as well as of roots, stems, and leaves, and in length of stems and leaves. Unfortunately, the plants were too young to bear and so there are no data on fruit yields.

Street Trees

Because soil around trees growing in cities is covered with paving blocks and sidewalks, it is impossible to feed them by means of the customary soil applications. To overcome this difficulty, a com-



Unsprayed linden tree behind truck cab had lighter green foliage than treated trees

plete nutrient spray was applied to the foliage of approximately 300 shade trees growing along the streets of New York City, pin oaks, London planes, Norway maples, little-leaf lindens, and American elms, varying in height from 15 to 35 feet.

Six applications were made, starting May 25 and ending August 4. Sprayed trees showed a decided increase in vigor and produced larger, greener leaves; foliage remained on the trees longer in the fall.

Most city soils are low in fertility. Smoke, dust, toxic gases, drought, sun scorch, and countless other factors also interfere with the growth and development of shade trees in the city. Trees in a vigorous condition are better able to withstand these unfavorable conditions, and foliar feeding helps to maintain their strength.

Other Tests

Hundreds of plants growing in the greenhouse and outdoors were used in another experiment. In the greenhouse were azaleas, Baltic ivy, boxwoods, chrysanthemums, coleus, euonymus, fuchsias, geraniums, hollies, Japanese barberries, lantanas, and yews. Outdoors were azaleas, boxwoods, chrysanthemums, grapes, London plane trees, rhododendrons, roses,

yews, and tomatoes. The difference in size, abundance, and greenness of foliage was obvious.

General

In all the tests, spraying was thorough, covering both the upper and lower surface of the leaves. A complete chemical fertilizer, with a nitrogen-phosphorus-potash ratio of 23-21-17 plus other minor elements was used—*Ra-Pid-Gro*; it is noncorrosive and completely soluble and does not clog the nozzle of the sprayer. The spray was prepared by dissolving a pound of *Ra-Pid-Gro* in 30 gallons of water. To increase its wetting power, a tablespoon of synthetic detergent (*dreft*) was added to the water. Most of the recommended insecticides and fungicides may be mixed with the nutrient to combine fertilizing and pest control in one application.

None of the sprays showed any injury to plants even when applied in the noon-day sun. Best results, however, were obtained when spray was applied in the morning, late afternoon, or evening.

Application of sprays is simple and requires no expensive or complex equipment. Best time to start is early in spring when soil nutrients are not so readily available. Continue applications every two weeks. If any solution re-

mainly unused, store it in a stoppered glass jug; it is nontoxic to humans and domestic animals and may be applied with safety.

Foliar feeding is no cure-all for plant ills, nor a substitute for good garden soil and proper care of plants. It is a helpful ally, a valuable stimulant.

LIQUID FEEDING

Plants grow and yield better

V. A. Tiedjens

Condensed from *Popular Gardening*, Aug., 1951

FERTILIZER solutions are gaining in popularity. Home gardeners are using them because they are safe and can be used in more ways than dry fertilizers and produce results faster. They may be made at home or may be bought in bottles or in the form of soluble dry salts.

Kinds

Any dry fertilizer may be put in water. If a 5-10-5 mixture is used, the solution will contain a 5-6-5 ratio because only part of the phosphorus will dissolve. The mixture should be made up 24 hours before it is used, and stirred several times.

Dry mixtures are available which have been prepared especially for solutions. These are usually higher in analysis and more soluble. We compared a number of these; the largest yield was obtained with a 1-2-1 ratio (nitrogen-phosphoric acid-potash). This mixture is comparable to a 5-10-5 dry fertilizer.

In fertilizer solutions sold in bottles, jugs, or barrels, a gallon contains 10 pounds of fertilizer. They are highly concentrated and must be diluted. The main objection to them is the cost. However, when the greater efficiency is figured, the cost is not far out of line with dry fertilizers.

When superphosphate is applied to the average soil as dry fertilizer, we can expect 20 to 25 per cent in our plants.

When the same amount is applied in solution, we can recover practically all.

One big advantage solutions have is that you can apply as little as a pound of fertilizer per acre. It can be sprayed on. But no fertilizer should be used unless there is a need for it.

Uses

Fertilizer solutions may be used for any purpose where dry fertilizer is used. The crop usually dictates the concentration. In most cases 10 pounds in 50 gallons are sufficient. These solutions may also be placed in a deep furrow and the plants set over it with 2 or 3 inches of soil between the solution and the roots.

They have given a good account of themselves as transplanting solutions or as starter solutions applied directly on the seed. Transplanting solutions contain the equivalent of 6 to 8 pounds of 5-10-5 in 100 gallons of water, or a tablespoon to a gallon. About $\frac{1}{4}$ to $\frac{1}{2}$ pint of the solution is applied to the roots before they are covered. Two precautions are: don't have any dry fertilizer in the soil surrounding the roots and don't press the soil around the roots when they are set with the solution. Shrubs, trees, and flowering plants may be fertilized with transplanting or starter solutions.

The newest development in the use of fertilizer solutions is the spraying of the solution on the foliage. [See page 235.] For this purpose the concentrated solution may be used or it may be used with other sprays or with weed killers. Liquid feeding offers possibilities of growing more crops with the same amount of fertilizer.

A GARDENER'S WORKROOM

Designed to speed outdoor activities

Abert J. Irving

Condensed from *Flower Grower*, Dec., 1950

NOTHING will increase the enjoyment of gardening so much as a carefully planned and orderly workroom.



Roche photos

Every item has its place. Fertilizer cans are labeled; tools and racks are numbered

Location and Uses

It may be a specially built structure or a part of your basement, garage, or barn, but it should be within easy access of the center of gardening activity. My workroom is attached to a small greenhouse on the edge of the garden, with a battery of cold frames just outside. It is the focal point of all my gardening work.

Lucky is the gardener who owns a small greenhouse; but without it, much early or late planting may be accomplished with cold frames and a hotbed. With these facilities, a workroom is a must. In addition to supplying a convenient place for storing tools, fertilizers, planting media, spray materials, pots, and flats, a workroom provides facilities for seed sowing, pricking out, transplanting, and potting. Here bulbs and tubers can be cleaned and prepared, and labels written. When heat and light are available in a workroom, gardening may continue despite inclement weather, either by day or by night.

It is an excellent spot for repairing, sharpening, and painting tools in off seasons, and just the place for making garden gadgets not available at the seed store. Here one may entertain a gardening neighbor; and if the male gardener is sufficiently open-minded, he may allow his wife to use the garden workroom for making flower arrangements.

Tools

A little time spent in the orderly arrangement of tools will be greatly appreciated later. A rack for tools and gadgets should be first on your list. A convenient holder can be made of two narrow boards placed horizontally, one above the other, and fastened edgewise against a wall. Large holes properly spaced can be cut

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for rakes, hoes, cultivators, and all other long-handled tools; flat pegs fastened to the top board in a slightly uptilted position will make room for shorter tools such as shovels, spades, and digging forks.

For small tools such as trowels and hand cultivators, a shelf of thin wood is useful if it is cut out at the front edge to catch the narrow shank of each tool. Appliances which do not lend themselves to hanging may be kept on the back of this shelf. Horizontal pieces of narrow wood or lath nailed across the upright 2 by 4's of a workshop will hold long garden stakes against the wall.

Tools painted a bright color can be found more easily when they are left in the garden. Their color also reminds the borrowing neighbor of his obligation. All my tools have numbers or letters stenciled on them, with corresponding numbers or letters on the racks.

Sink

A sink with running water is convenient for watering seed flats and pans, and washing pots. My scrubbing brushes are stored over the sink, while pots, pans, and flats are stacked under the sink and its homemade drainboards. A cupboard above, made of salvaged materials, houses seeds, spray materials, flower-arranging materials and containers, and a host of small things.

Seeds

To discourage mice, small seeds are kept in large metal-covered tins, and larger seeds in discarded bread boxes. A gourd nailed to a rafter is an excellent device for holding string. A hole large enough to introduce the ball is made on one side, with a small hole on the other side, where the end of the cord emerges. Above this hangs a pair of scissors. A box of broken flower pots or crocks to be used for drainage should always be present on the bench.

Soil

My soil, peat, and leaf mold are stored in 50-gallon oil drums which have been

cut down to allow them to be pushed under the work bench when mounted on dollies. A handle is fastened to each drum. Old milk cans are excellent for storing fertilizers, lime, and other less bulky material. Since the containers are likely to rust, I give them a coat of red lead after cleaning and before painting them. The name of the contents is painted or stenciled on the side.

Homemade Gadgets

Making useful garden gadgets from odds and ends, at practically no cost, is almost as great sport as their actual use.

A pound coffee tin can be made into a small sifter, with the bottom cut off and a piece of metal screen stretched over one end. Copper wire is best for netting,



Pots and brushes stored near sink, other small things in cupboards



A good potting bench, with tools nearby. Oil drums of soil, under the bench, on platforms on casters

which can be held in place by a piece of wire tightly drawn up around the sides of the tin. For a finished job, the netting should be soldered to the edge of the tin,

the wire removed, and any excess trimmed.

You can save time in transplanting seedlings by using a spotting board. This may be made from a heavy piece of soft wood of a size which loosely fits within a seed flat. Holes spaced 2 inches apart each way may be made through the board. When this is placed over the flat, a dibber can be pushed through the holes into the soil. Another way is to drill holes part-way into the board and glue short pointed pieces of dowels into them. Handles should be provided on the opposite side of the board. With this device, spotting is accomplished in one operation by pushing the points into the soil. Your imagination will soon lead you to many other useful garden gadgets which you can put together in your workroom in your spare time.

Two items to be begged or quietly pilfered from the kitchen are useful in the workroom. A strainer serves the same purpose as the coffee-tin sieve. An old-fashioned four-tined steel kitchen fork, with the tines bent at right angles about midway, is the best known cultivator for potted plants and flats.

With a properly planned working space, and tools, materials, and accessories in order, time will be saved, drudgery eliminated, and the pleasure of gardening greatly enhanced.



Spotting board, rear left; dibber and potting stick leaning against it. At the right of these are sieves — one made from a coffee tin; in front are tampers and furrow-makers

HOW TO GROW MUSHROOMS

All you need is a cool moist place

F. F. Rockwell

Condensed from *The Home Garden*, Dec., 1951

GARDENERS whose memories go back more than a few years will recall the advertisements telling them how to grow mushrooms in their own cellars. The procedure recommended was not practical. The method required materials not readily to be had, and a technical skill beyond that of the average purchaser.

Recently a new technique has been developed that makes growing mushrooms at home practical for almost anyone. To

grow mushrooms by this system, the only requisite is a place where you can provide the correct combination of temperature and humidity. Mushrooms grow perfectly well in the dark; but even darkness is not essential; they also thrive in the light, although direct bright sunshine is undesirable.

Temperature

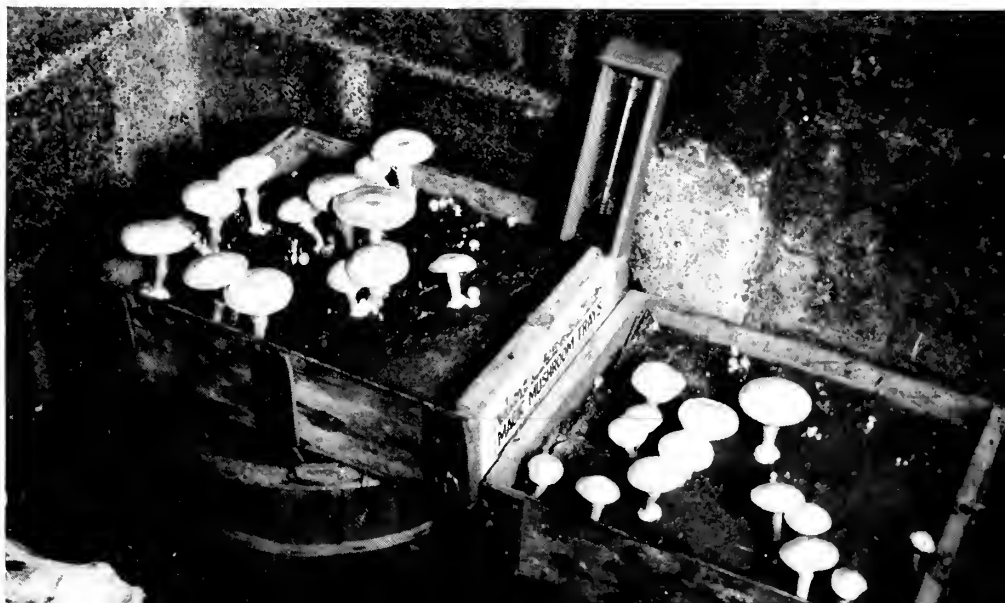
The ideal temperature is a constant 60°; but this can vary 5° in either direction, and for occasional short spells as much as 10°, without serious results.

The prospective grower should make tests with a thermometer, to locate a spot where the mercury will hang fairly close to 60° day and night. At different levels in the same room, or in different corners, there is often a difference of 10°, some-

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The first crop; left to flatten out before picking, they're bigger, more flavorful than small caps

Author courtesy



times more. A table, a bench, or a hanging shelf can be arranged to support the trays where the temperature is nearest to ideal. If they are placed on the floor, support them on bricks or pieces of wood to provide a few inches of space for air circulation under them.

Moisture

The ideal is an earth floor in a cellar separated from the central heating plant. Lacking that, the trays may be covered with a piece of blanket, burlap, or similar moisture-retaining fabric. On a cement floor in the same room with a heating plant, frequent wetting of floor and walls near the trays is helpful.

Trays

Your prepared mushroom bed will be one or more deep flats about two thirds full of prepared compost, covered with heavy paper. On top of the paper is loose topsoil, somewhat on the clayey side. Mushroom trays may be ordered without the topsoil, which can be supplied from your own garden; but there is no saving except in the cost of transportation.

The compost has been planted and left under proper conditions long enough for the spawn to spread through the mass. When you receive it, the spawn is in an arrested state, ready to renew growth as soon as favorable conditions are provided.

Care

To start the trays into growth, remove the paper, add an inch of topsoil, and give it a fairly thorough watering. If the soil is lumpy, it should be pulverized or sifted to get a uniform, even layer.

The necessity for additional watering will be indicated by the condition of the soil. This should be examined every few days, and when it dries enough to be powdery to the touch, it should be watered sufficiently to penetrate the topsoil. *The compost underneath, however, should never be saturated.* In a damp cellar, one watering a week will usually be ample. In drier air, two or three sprinklings a

week may be necessary. The drier the air, the heavier should be the covering of damp cloth; and it should be removed only for gathering the mushrooms.

Harvesting

If conditions are favorable, in about twenty-one to twenty-five days little white dots, at first not much larger than pin-heads, should begin to appear on the surface. They will not be scattered evenly, but clustered in colonies. Later, other colonies will appear at different spots. Each of these successive growths is termed a "flush."

Once they have emerged, the tiny white specks will develop rapidly, and in a week or ten days the largest ones should be ready for gathering.

Do not be in a hurry to pick your first mushrooms. They have more flavor when the cap has expanded sufficiently to break the tissue connecting it with the stem, and has opened out almost flat. Commercially grown mushrooms, to be shipped, have to be gathered in an immature, tight state in order not to be bruised or broken in transportation and handling. Growing your own at home, you can have them really "ripe."

In gathering the mushrooms which are ready for picking, exercise care not to disturb the soil, as this may destroy others which are just breaking through. A light pressure with the fingers of the left hand at the base of the stem will keep the soil firm, while the stem of the mushroom being picked is twisted off at ground level with the right hand. We sometimes use a thin-bladed grapefruit knife when the stems are growing in a close cluster, to cut them off at ground level.

Size is not a safe guide in determining when mushrooms are ready for gathering. They should never be left after the tops have opened out flat no matter how small they are, as they remain in good condition for only a short time.

The trays will continue yielding for many weeks, if temperature and moisture conditions remain favorable—sometimes for three months or more.



Author courtesy

THE MURDER OF A LANDSCAPE

Shortsighted exploitation has made 100 square miles of southern countryside an almost hopeless desert

Edwin Way Teale

Condensed from *Natural History*, Oct., 1951; now one chapter ("The Poisoned Hills") of the book *North with the Spring*.

ALL that morning, in the April sunshine, our road had carried us through mountain forests, green and lush. Then, like a pleasant dream sliding into

a nightmare, the country swiftly changed.

The forest thinned away. The trees grew smaller, became stunted, disappeared. Bushes shrank and vanished. Grasses died away. All around us, dead hills, ribbed by erosion, stood stark in the sunshine. Hardly two miles from dense woodland, we were in the midst of a land of desolation, a hundred square miles of poisoned earth.

We were in the southeast corner of Tennessee, in the Ducktown Desert of the Copper Basin, where three states, Tennessee, North Carolina, and Georgia, join on a desolate elevation which bears the ironical name Pleasant Hill.

Copyright, 1951, by the American Museum of Natural History, New York 24, N. Y. Book copyright, 1951, by Edwin Way Teale; published by Dodd, Mead, New York.



Photos courtesy U. S. Tennessee Valley Authority

Reclamation work was begun here in November, 1941. Prior to planting, check dams were built in gullies, and straw mulch spread

All the hills were pleasant here less than a hundred years ago. What had produced this desert in the midst of a green landscape? It is a classic tale of land abuse, the murder of a countryside.

Until about 1840, hardwood forests clothed the hills, and shaded brooks meandered toward the Ocoee River. Then copper ore was unearthed and a scramble of fortune hunters began.

Cutting the Forests

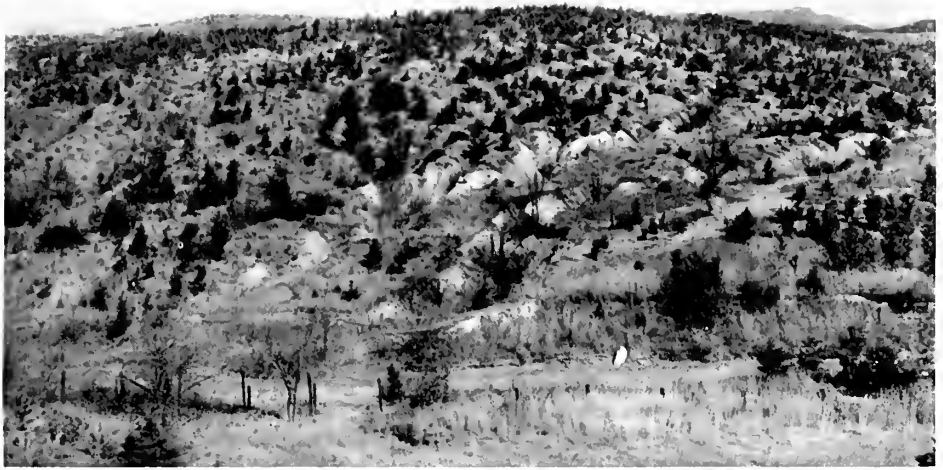
It was a custom, in the early days of copper mining, to roast the ore under large log fires before placing it in the furnace. This eliminated the sulphur. As the Ducktown area developed, the demand for wood mounted. Axes rang all day long. The forests receded in an expanding circle.

Fire and Poison

The flaring piles of wood ignited the surrounding grass and bushes. In dry weather, almost daily fires swept the earth bare of vegetation. It came back; but always it was consumed again.

Even worse than ax or fire was a third enemy of the vegetation: the clouds of sulphur dioxide gas that rose from the roasting piles. Different kinds of vegetation respond in different ways to the poison of this gas. Blue violets turn green. Larch trees are highly susceptible in spring but more resistant in fall. Hemlocks, white pines, and sycamores are easily killed by the gas; red maples, white oaks, and black gums are more resistant to it. On still days, when there is fog or high humidity, the damage is greatest. In addition to attacking the growing plants, the sulphur dioxide entered the soil and tended to increase its acidity.

By the end of the roast-yard era, about the turn of the century, all the trees were gone from the region, and all the lower forms of vegetation were going. Patches of bare soil expanded. Those twin instruments of erosion—the rain and the wind—did the rest. The climatic extremes and the heavy rainfall of the region speeded the destruction. Swiftly the fertile topsoil slipped away down Potato Creek, down Bushy Creek; millions of tons of it washed away as silt down the Ocoee and



The same area six years later. Definite progress is shown, but the work is expensive and slow

the Tennessee, down the Ohio and the Mississippi. Left behind were the raw hills of sterile undersoil. They rose around us as far as we could see.

Animal Life

Only a few minutes before, small birds had been everywhere. There, life was at an exuberant peak. Here, it seemed almost absent. We heard the song of a field sparrow on one of the patches of sod that still clung to an eroding hillside. We saw three English sparrows picking on the bare ground before a house on a treeless plain. But we saw, in all that accursed red land, only one wild songbird among the many millions then migrating north—a white-throated sparrow. Near the edge of the desert, half a dozen cows wandered about, feeding as best they could on the sparse pasturage.

Insects, like other forms of life, are scarce in the Ducktown Desert. We saw a few small blue butterflies. Once we discovered minute red ants racing wildly, bumping into each other, milling about a small dead caterpillar. Here was a great prize in this austere land.

Temperature and Moisture

I laid down a thermometer beside the anthill. Its mercury touched the 115° mark. Without vegetation, the bare hills of the Copper Basin heat up rapidly under the sun and cool off just as rapidly with the coming of night.

In other ways, the disappearance of vegetation has modified the local climate in these badlands of the South. During summer the heat is usually greater at the eastern edge of the area. The prevailing winds are from the northwest. They flow across the bare ground and are heated as they go. Moisture in this red soil evaporates at an abnormally rapid rate, five times as fast as on the floor of the neighboring forest.

Attempted Remedies

The U. S. Supreme Court, about 1907, ruled that the copper companies were responsible for controlling the sulphur dioxide they had been pouring into the air. In consequence, special equipment was installed to recover sulphuric acid from the smelter smoke. Today, the Copper Basin

is the largest producer of sulphuric acid east of the Mississippi. To aid in dispersing what fumes remain in the smoke, higher smokestacks were built, one of them 400 feet high!

Sulphuric acid—which played an important part in the destruction of plant life here and was wasted for many years—is now one of the strategic materials of which we are critically short. It would have been good conservation for more than one reason to have reclaimed it from the start. We have not yet learned the lesson of Ducktown. Hundreds of factories all over the United States are still discharging noxious materials into the air that could be reclaimed at an eventual profit.

Can the Ducktown Desert ever come back? Extensive researches were carried out in the area before the Second World War. Hundreds of thousands of trees were planted. Check dams, formed of brush and hog wire, were set up in the gullies. Hilltops were mulched to retain moisture and prevent runoff. From Africa, Japan, the Mediterranean countries, plants were brought to Tennessee and tested as cover for the poisoned hills.

In nearly a hundred different plots the scientists tried out plants with strange names and remote origins—kudzu, Sudan grass, trailing lespedeza, Italian rye grass, crown vetch, Bermuda grass, bird's-foot deer-vetch, Bahia grass of the Pensacola strain. And one by one, the research scientists crossed them off the list. A single plant, weeping love grass (*Eragrostis curvula*), native to South Africa, proved useful in the completely denuded areas. Of the innumerable trees tested, two kinds, both native to the region, proved best. Black locust showed itself most effective in the gullies and pitch pine on the eroded hillsides.

More than 2,400,000 trees had been set out. We looked around us. A few small clumps of pines were the trees that had survived—an almost negligible number. The vast majority had succumbed to the insurmountable conditions in this desert produced by man.

So far, man has failed to undo the damage he has done. Unless more effective aid is forthcoming from man, the desert has only the long hope of Nature's slow repair.



Most of the area remains a desert, though water is not lacking. The topsoil is gone and nothing will take root on the steep slopes. This land should never have been denuded

Author courtesy

Have You an Idle Acre?

IS REFORESTATION PRACTICAL?

Where is it necessary—how is it accomplished—what does it cost?

E. R. Wagoner

Condensed from *The Forest Farmer*, Nov., 1951

REFORESTATION is the reestablishment of forest cover by either natural or artificial means.

Published by the Forest Farmers Association Cooperative, Valdosta, Ga.

Natural reforestation, that is, young trees from seeds scattered by large trees on the area, has the advantage of requiring no capital investment for equipment and little or no expenditure for labor; but there is the disadvantage of less control over the species of trees established, the time of establishment, and the evenness of the stand.

Artificial reforestation is accomplished by planting seeds or small seedlings. With

A young privately owned stand of white pine in the Catskill Mountains, New York. Seedlings were 3 to 4 inches tall when planted by hand, nineteen years ago

Harold Swahn





Cut-over land in the E. O. Siecke State Forest near Kirbyville, Texas

Photos courtesy Texas Forest Service

this method there is complete control over the species, the time and place of establishment, and the uniformity and density of the stand; but it requires a substantial investment per acre for labor and planting stock.

Artificial reforestation is needed generally as a result of overcutting or of fire. It is used to form a complete cover on areas where natural reforestation has failed or is very slow in asserting itself, to reforest land abandoned for the production of crops, to create a soil cover on land that is used for collecting surface waters, that is, on reservoir watersheds, or to change the tree species.

Artificial reforestation is needed on thousands of acres. On much of this land, the planting of forest tree seedlings is necessary if the areas are to become productive.

Methods

Planting seedlings by hand and planting them with a mechanical tree planter are the proven methods of artificial reforestation. Direct distribution of seeds on sites where trees are to be grown usually has failed.

Hand Planting may be more economical on a small area than planting by machine. Hand planting may be the only practical method in communities where planting machines are not available.

Very little equipment is required for hand planting. A tool commonly used is the planting bar.

One who has only a few acres to plant may do his own planting, but two or three men may be able to plant seedlings more economically than one man working alone.

Hand planting can be done on any kind of land. Stumps, trees, gullies, and other obstacles interfere less with hand planting than with machine planting. Areas too wet or too small for the operation of a tractor can be planted by hand. On soils too hard for successful operation of planting machines, hand planting is the practical alternative.

Machine Planting. Economy and speed are two of the advantages of this method. Investment required is one of the first considerations. The cooperative purchase of a planter by several small landowners reduces individual investment in equipment. Some individuals operate tree planting machines profitably by planting seedlings for other landowners. Civic organizations and industrial concerns have purchased tree planting machines and made them available to landowners.

Mechanical planters are not adapted to small openings in dense woods or to fields of less than 10 acres. Light, friable soils are best suited for machine planting.

The same land reforested with slash pines now in their 24th year



Care of Seedlings

Heeling in. Whether the seedlings are planted by hand or by machine, the rate of survival is to some extent dependent upon how they are handled after they are received from the nursery. If they cannot be planted immediately, they should be heeled in, in a "V"-shaped trench. Each small bundle should be broken open, and the trees spread along one side of the trench. Cover the roots and the lower portion of the stem with soil, packing it tight around the trees. Water immediately and as often thereafter as needed.

Heeling in should be in light, well drained soil. Seedlings should be protected from wind and sun.

Planting. Even though seedlings are heeled in, they should be planted as soon as possible after they are received. When ready to plant, remove only those trees which can be planted immediately, and place them in a bucket with wet moss over the roots—or water or creamy mud. Wet moss is lighter to carry. When temperatures are near freezing, planting should not be attempted.

It is essential that seedlings be planted at the same depth at which they grew in the nursery. The distance between rows and between seedlings in the row, is dependent upon the species and upon the purpose of the planting. A planting to control erosion would be spaced much

closer than a planting to produce saw logs.

Naturally, some trees will die during the first year or so following the planting. If a plantation is not protected from grazing and from fire, a much smaller percentage of survival can be expected.

Cost

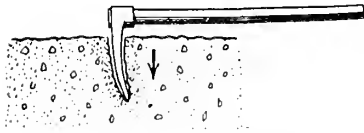
The cost of artificial reforestation varies considerably according to the initial cost of seedlings, the cost of labor, and the terrain involved. In many places much of the cost can be offset by the receipt of PMA (Production and Marketing Administration) payments, providing approval is obtained in advance from the local PMA office. Local foresters and county agents will gladly help landowners solve their reforestation problems. In some cases seedlings are available without charge. In no case is the charge more than a few dollars per thousand trees.

Need

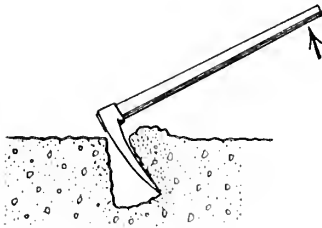
Millions of acres of idle land can produce a profit if the landowners will artificially reforest the lands which are not economically suitable for other purposes and do not have a natural seed source. An expanded artificial reforestation program is helping and will continue to help assure "trees forever" to meet the great demand for wood and the countless products made from wood.

Planting Tree Seedlings by Hand

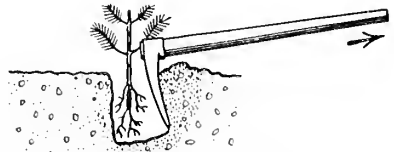
With Mattock



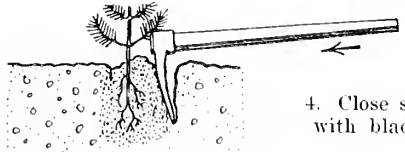
1. Drive blade straight down



2. Open slit by raising handle



3. Open top of slit by pulling mattock back and pushing handle down



4. Close slit with blade

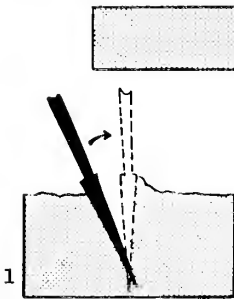


5. Tamp soil with heel

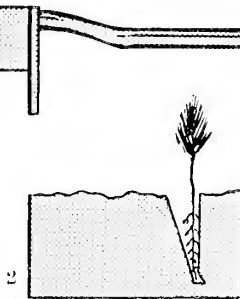
Courtesy U. S. Dept. of Agriculture

With Dibble

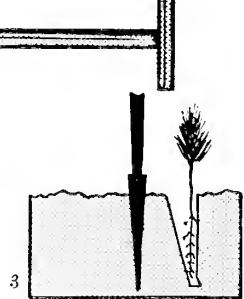
Dibble, or planting bar



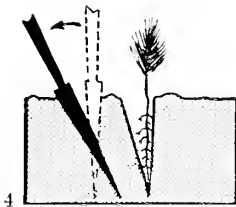
1 Insert dibble at angle, push forward to upright position



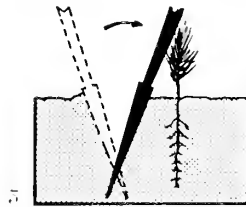
2 Set seedling at same depth as in nursery (or $\frac{1}{2}$ inch deeper), roots nearly straight



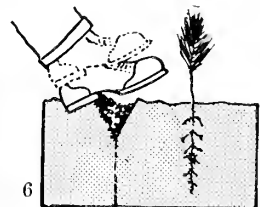
3 Insert dibble 2 inches toward planter from seedling



4 Pull handle toward planter to pack soil at the bottom



5 Push handle forward to pack soil at top



6 Fill in last hole and pack soil around seedling with heel
From various state forestry leaflets

HOW TO PICK A HOME SITE

To make the best use of the trees

Martin L. Davey, Jr.

Condensed from *Popular Gardening*,
March, 1951

To avoid heartbreak and expense, an expert should be called in to give an objective appraisal as soon as the prospective homeowner has decided that the community suits him and the site meets all major requirements. Most reputable tree men and landscape architects are glad to inspect property at no cost.

Almost everyone wants trees on his place. Real estate people in most cases

charge more for a wooded plot. Yet some, or even all, of the trees that increase the value of the property may be undesirable for one reason or another and may have to be amputated at great cost.

Many people buy properties with large trees that have weak or splitting forks. V-shaped forks are generally weaker than U-shaped ones. The weakness or actual split may not be discernible to the property owner, but it is quickly apparent to the experienced tree doctor.

In addition to the initial appraisal, the property owner needs reliable counsel to

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House located to take advantage of natural setting

Photos courtesy Davey Tree Expert Co.





The trees which were retained for the finished landscape, shown on the opposite page, can easily be identified in this picture through the brush

help him determine the proper location of the house, garage, and driveway in relation to the valuable trees on his grounds.

He also needs advice on how best to safeguard trees from construction hazards. Some builders have no regard for trees. It is wise to stipulate in the building contract that guards be placed around the important trees to prevent injury;

that no construction material be piled around trees and that no clay be used to fill in around one. Sand, gravel, and other porous materials allow water and air to get to the root systems, but clay does not. During construction, the mortar box should be placed at a distance from valuable trees because lime and plaster may cause trouble when spilled on the ground.

Do's and Don'ts

DO'S

1. Check for desirable trees.
2. See that they are favorably located in relation to proposed house, garage, driveway, and underground utility installations.
3. If planning to transplant mature trees on site, consult with a competent nurseryman or tree-moving expert. Some native trees resent transplanting.
4. Check for desirable species that have longevity, vitality, health, and structural strength.
5. Adapt building plans to the arboreal setting, if possible.
6. In your building contract, stipulate that guards be placed about valuable trees and that building materials *not* be heaped about them.
7. Consult a tree expert before making your *final* selection of site, and during actual home construction, to help protect your tree assets.



House has been set at top of natural slope; roots of trees have not been disturbed; natural grade at right permits basement garage

If possible, it would be well to have an expert on hand as the building progresses. He can see to it that sewers, service lines, and driveways are constructed with minimum injury to trees. He can prevent burying trees during grading operations. When the soil level is raised, a tree may be smothered to death for lack of air to its root system. Lowering the

soil level is dangerous unless care is taken to prevent exposing roots. Construction workers attach cables and ropes to trees to use as guy lines for hoists and derricks. Many a tree has been killed by girdling.

It is better to buy treeless property and plant trees than to buy a too-heavily wooded tract.

(Continued on next page)

for Picking the Home Site

DON'TS

1. Don't built your home too close to a mature tree, or major roots will be destroyed.
2. Don't buy property with too many large trees unless they are well spaced and located.
3. Don't buy property studded with big ugly stumps; removal may be expensive.
4. Don't determine too quickly the location of the house on the lot. A slight change might save more of the best trees.
5. Don't let the building contractor attach ropes or cables to your trees as guy wires for derricks or other construction equipment.
6. Don't unnecessarily raise or lower the grade around trees without expert counsel. Root systems may be damaged.
7. Don't buy a property for its trees until you have had them appraised by a qualified tree man.



Certain kinds of trees resent transplanting after passing the sapling stage. Among these are beech, walnut, hickory, redbud, and most oaks.

Among the generally more desirable shade trees are many varieties of oak, red and sugar maples, the honey-locust, ash, linden, sweet and sour gums, and native evergreens such as pine, arbor-vitae, spruce, and juniper.

Elms, because of diseases, are potentially heavy liabilities, especially east of the Mississippi.

The beech cannot stand drastic environmental changes—it is allergic to civilization.

Before building your house or removing trees, then, consult a tree expert and remember that all is not green that flutters; an ounce of prevention is better than a pound of cure; only God can make a tree.

A tree expert would advise against buying a lot having a large tree with a weak fork which will some day split like this

TWO POOR TREES FOR ORNAMENTAL PLANTING

Two trees which have been overemphasized in ornamental plantings are the common catalpa (*Catalpa speciosa*) and the European horse-chestnut (*Aesculus hippocastanum*). Both are large and coarse in growth habits and difficult to work into the planting plan unless there is a great deal of room available for their future development. The fruits of both are not ornamental but cause a considerable amount of cleaning work as they fall. Neither has colorful autumn foliage. Both grow quickly and because of this are not expensive. Their low price tricks unsuspecting homeowners into buy-

ing them; but they really are not good trees, particularly on the small place. Their flowers are large and conspicuous, but that is about all that can be said in their favor. The European horse-chestnut is frequently susceptible to a serious rust disease which disfigures the foliage in late summer, often months before the foliage normally falls in the autumn.

These trees should never be used on the small home grounds and should be planted elsewhere only after the many other ornamental trees available have been given first consideration.

DONALD WYMAN

ELM AILMENTS

Minor diseases with symptoms resembling those of Dutch elm disease and phloem necrosis

Noel Wysong

Condensed from *American Nurseryman*,
May 15, 1951

HOMEOWNERS who discover wilted or discolored foliage on their elms may fear that their trees are infected with Dutch elm disease or phloem necrosis.* There is always the chance that either of these killers may be found. However, there are a number of less serious diseases with similar symptoms.

Scorch is common in areas of abundant rainfall in spring followed by summer droughts and drying winds. The moisture in the soil during leaf formation induces growth of a greater amount of leaf surface than can be supported during the summer drought periods. Affected leaves become yellow or brown along their margins, the dying areas frequently extending into the tissue between the veins. In severe cases, defoliation may occur. Treatment includes fertilizing and watering.

Wetwood (slime flux). Air-borne bacteria, yeasts, or fungi often lodge in the sap oozing from saw cuts or other wounds that penetrate the sapwood, and cause it to become slimy and malodorous. A bacterium causes fermentation of sap and production of gases in the trunk. Sap accumulates in the infected wood, and when it is taken up in sufficient quantities by the current-season growth tissues, wilting of foliage on one or more

branches occurs. Pipe drains to carry away fluxing sap are recommended.

Verticillium wilt. In elms affected by this disease, the foliage on a single branch or on one side of the tree may wilt, turn yellow, and fall. The causal agent is a fungus in the soil. It usually attacks through the root system, but insects can carry it and cause infection through wounds. Infected branches usually show brown streaking beneath the bark in the outer rings of the sapwood. Since similar external symptoms and streaking of wood are found in trees affected with Dutch elm disease, positive diagnosis can be made only by laboratory tests. Treatment consists of pruning out all infected branches and making a liberal application of fertilizer to stimulate new growth. Tools used in pruning out infected branches should be sterilized by being dipped in mercuric chloride or other fungicidal material before being used on other trees.

Dothiorella wilt (elm dieback) causes wilting of the foliage, dieback of the branches, and discoloration in the outer rings of sapwood. It cannot be positively distinguished from either verticillium wilt or Dutch elm disease except through laboratory tests. It is caused by a fungus, the spores of which are disseminated by rain, wind, and possibly insects. Infection occurs through wounds in the leaves. Cankers (depressed dead bark areas) frequently develop on affected branches. Since infection usually progresses from the leaves toward the trunk, the disease can often be eradicated by pruning the affected branch well below the lowest point of discoloration.

Leaf spot. Several fungi attack the leaves directly and cause death of portions of leaf tissue. On early spring foliage the fungus causes white or yel-

*Described and illustrated in *Plants & Gardens*, Summer, 1951, pages 129 to 135.—Ed.

lowish spots on the upper leaf surfaces. These spots increase in size and turn black, and the disease may cause defoliation. Other leaf spot diseases kill the leaf tissue along the midrib, veins, and margins or produce irregularly shaped brown spots on both the upper and lower leaf surfaces. The recommended control consists of raking up and burning fallen, infected leaves and application of a foliar spray containing a fungicide.

Insects such as the European elm scale may cause death of branches not unlike that resulting from fungus diseases.

Nonparasitic agencies. Leaking gas mains, grade changes, mechanical injuries, and other disturbances of normal conditions may cause a decline in the health of a tree which is evidenced by death of branches and foliage.

Elm phloem necrosis and Dutch elm disease cause wilting of foliage and death of branches. But so do many other elm tree troubles. In attempting to diagnose any elm disorder, one should not overlook the probability that these symptoms may be of one of the more common but less publicized ailments.

NEW FACTS ABOUT THE OAK WILT FUNGUS

The past year's research has brought to light some new facts about the fungus which causes oak wilt disease. Its real identity was never clearly established, and up to now it has been called *Chalara quercina*.

The recent discovery of the "perfect, or fruiting, stage" of the fungus makes possible its accurate identification for the first time. This recently produced "perfect stage" is a condition which has never been found in nature and was discovered only as a result of laboratory experimental work. The fungus is now known to be a species of *Ceratostomella*; another species of *Ceratostomella* causes the Dutch elm disease.

New hosts for the oak wilt fungus have also been found. In addition to the Chinese chestnut and the native oaks reported in the 1951 summer issue of *Plants & Gardens*, tan-oak (*Lithocarpus densiflorus*), bush chinquapin (*Castanopsis sempervirens*), European chestnut (*Castanea sativa*), and Asiatic oak species (*Quercus acutissima* and *Q. densata*), have been found to be susceptible when infected under laboratory conditions. The symptoms of these new hosts seem to follow those reported in the summer issue of *Plants & Gardens*, pages 123 to 128.

(Condensed by George A. Vradenburg from abstracts of papers presented at the December meetings of the American Phytopathological Society at Cincinnati, Ohio.)

A NEW KIND OF NEMATODE

The most destructive and best-understood nematodes, the minute parasitic worms which cause the widespread root-knot disease, are "endoparasitic"—they live and do their damage chiefly inside the roots of plants. Recent findings indicate that another kind of nematode lives on the *surface* of plant roots. The nematodes of this kind are therefore "ectoparasites"; they are present in large numbers in some soils, and they, too, can be very injurious to some crop plants,

Examination of screenings of soil from around the roots of diseased tobacco, cotton, corn, and other plants shows that these ectoparasitic nematodes are important parasites on these particular plants.

Greenhouse tests indicate that certain ectoparasitic nematodes are selective as to the plants which they attack; one may be partial to tobacco and cotton; another to corn, cotton, and various grasses; and still another to cowpeas, soybeans, and strawberries.

reasonable.

—28.

WANTED TO RENT—Large, level garden space adjacent to private home or on estate, accessible by L-2 or L-4 bus. "out Connecticut." Advertiser, trapped in apartment without car, is business executive, amateur horticulturist, garden show winner. Not a "victory gardener." Need small storage space for hand tools; will work alone and asks to be let alone, but owner may share produce if desired, and value of land will be enhanced. None with "helpful small children" need reply. References exchanged. Call Extension 118, Hobart after 8 p.m.

—15

ONE 4-IN. PORTABLE TREE S.W.

THE "GREEN THUMB" CLAN ANSWERS AN AD

*Out of its yearning to make
something grove in the earth*

Gerald W. Movius

Condensed from *The Evening Star*,
Washington, D. C., May 15, 1951

To the Editor of The Star:

ALL I wanted was to rent a garden space. I invested \$6.08 in classified lineage in The Star. What I got for my money was a rich, new knowledge of the

tug of the soil at the human heart, and a warm reminder of the fraternal tie that binds the Order of the Green Thumb.

The Ad

The ad itself was on the saucy order. "That," I advised my wife, "is a masterpiece. It insults people with small kids, and they won't call. It makes me out the chilly, brooding type, and that eliminates the mob that falls in love with seed cat-

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alogs. We won't hear from anyone except a few practical souls within shooting distance."

The Answers

Forty-seven persons called; three or four called two or three times—and one called seven times. No call was in the nuisance class. The majority were from people who read into my flippant language an expression of the yearning in their own hearts—the yearning to make something grow in the earth.

For five evenings, I was anchored to my telephone. Strangers poured out their family troubles, their illnesses and mortgage problems. Drunks with weird real estate propositions cursed me out for not accepting them. A displaced person pricked my conscience by saying that he who loves the soil must have one time walked with God.

There were finishing-school accents and garbled English; Dixie drawls and the hard-hit "r" of the Northwest. There were invitations just to "come see us and tell us what's wrong with our garden"; bids to commute me back and forth to remote spots miles beyond the District boundaries.

There was the woman who told me the little plot she had wouldn't suit me, she knew—but she wanted to talk to me anyway. "I do love to dig in the earth, but now I must do it from a chair."

There was the young fellow whose wife had been suddenly sentenced to a prolonged bed rest. "We got this place and were going to have our first garden—and now she's ill. I'm growing some tomato plants in the basement, and something green is coming up. Do you think it's the tomatoes?" He was afraid his place was out of my way, but he hoped it would suit me, for he didn't know much about gardens himself. "But wouldn't it be wonderful to have something growing to show her by fall?"

There was the lass with the gay, bubbly voice typical of a certain social set. It was about her father-in-law she was calling. He had a "marvelous yard," but

he wasn't up to working it himself, and he was a little crochety and couldn't stand hired help. "But if you'd take it over—you'd love father, and if he could only meet you first. . . ."

There was the chap with "a whale of a deal for me," and he was among those who had obviously communed at some length with labeled spirits. "Out of the Army after 30 years; got myself 22 blankety-blank acres and a blankety-blank swell new station wagon. Going to farm this blankety-blank real estate, too. Only I need a guy who knows what it's all about. Haul you out and back any time—day or night." I had a mental picture of self and ex-Army chum careening madly toward his 22 acres in his brand-new station wagon. I regretfully begged off. He called me a blankety-blank, and hung up.

The Explanation

I marveled that the tug of the soil could be so evident among so many people who patently had little or no experience with the earth. I marveled, too, how the tug of the soil survives the industrial age—and a diet of vegetables seemingly planted and grown in the deep-freeze at the corner market.

It never dawned on any of those priceless, delightful, and sometimes pathetic people that they might be wasting time for a guy who had advertised a business proposition. It never dawned on me to say so either. For a moment, I was high priest and confessor in the Mystic Order of the Green Thumb. I reveled in it—and I was humbled.

I never found my garden space. Every offering was outside my geographic limits. But no one ever mentioned rent, and each one to whom I put the question brushed it off.

"Just tell him he can have our lot for nothing," said a message relayed to me by a helpful soul who unfortunately forgot the call-back number that came with it. "Tell him we know how he feels. Tell him we know what it's like to have a green thumb—and no place to exercise it."



J. I. Soper, courtesy Canadian Geographical Society

This wind swept stony slope on Baffin Island harbors many snowy flowers in its short growing season

PLANT LIFE IN THE ARCTIC

*How plants survive in
the Far North*

A. E. Porsild

Condensed selections from the *Canadian Geographical Journal*, March, 1951*

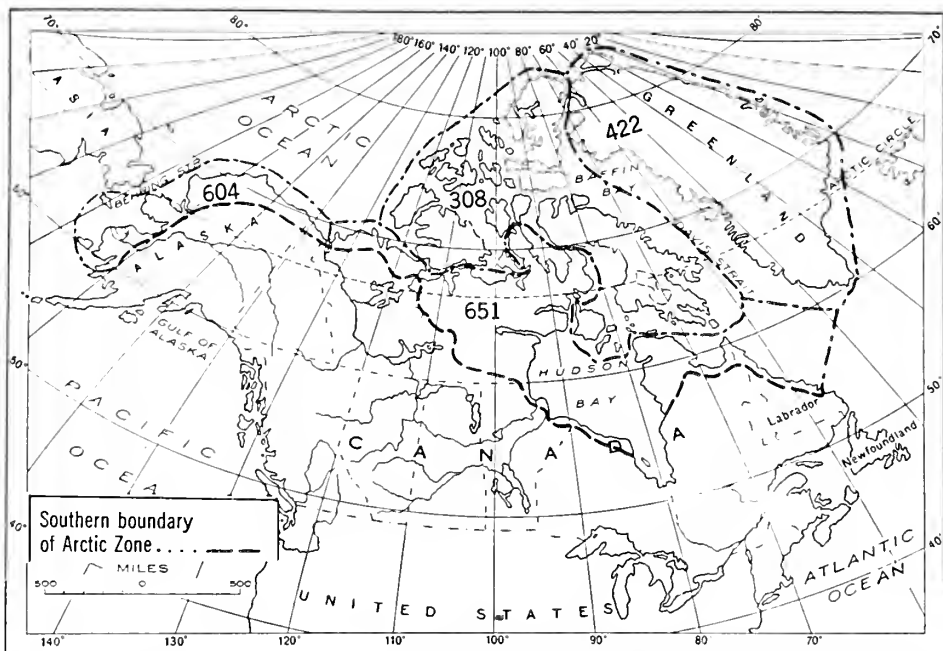
Published by The Canadian Geographical Society, 36 Elgin St., Ottawa, Canada

VERY few people realize that as far north as land reaches towards the North Pole, botanists have found numerous species of flowering plants besides lower forms of plant life.

From north Greenland, north of the 80th parallel, seventy-six species of flowering plants and ferns have been recorded. Grass, willows, and herbs grow abundantly enough to furnish pasture for numerous herds of caribou and musk-oxen.

The most striking single feature of the Arctic is the absence of trees. There are small numbers of woody plants—willows, ground birch, and various kinds of berry bushes and heather. These become dwarfed north of the tree line and are generally restricted to places where protecting snow cover is assured during the winter. On the Arctic Islands their numbers rapidly dwindle. The willows here become low and trailing and the berry bushes disappear entirely. On the southernmost islands of the Canadian Arctic Archipelago, a few of the berry bushes are still to be found, but they no longer produce fruits; and farther north they drop out entirely. On Melville Island, credited with a flora of about eighty-six kinds of flowering plants, there are but two species of woody plants: the prostrate arctic willow (*Salix arctica*) and the white-heather (*Cassiope tetragona*).

*Reprints of the complete article (including more photographs and distribution maps, and a discussion of the ecology of the region and problems in arctic botany) may be had from the National Museum of Canada, Ottawa, at 50 cents each.—Ed.



Maps and photos courtesy Canadian Geographical Society

Bold-face numerals indicate numbers of different species in each area

Owing to the severity of the climate and the short growing season, the rate of growth in arctic plants is very slow. Many species require a long period of years before they flower and fruit for the first time. This is especially true of woody plants. In trailing stems of juniper or Lappland rhododendron, no thicker than a man's thumb, 400 annual rings have been counted.

Climate and Soil

In the Arctic the short growing season is compensated by the continuous daylight. Many arctic plants are "long-day" plants; and when transplanted or grown from seed in lower latitudes, they flower poorly or not at all. Conversely, some "short-day" plants, native to temperate or tropical countries, do not flower or reproduce well if grown under glass in the arctic continuous daylight.

In polar regions, particularly in the central parts of large continents or islands, precipitation is very light, often totaling under 7 inches for the year. The winter snowfall is light, and frequent gales sweep the snow off the level ground, exposing the plant cover to the drying

effect of the wind. So light indeed is the rainfall during the growing season that were it not for the fact that the soil remains perpetually frozen a few inches below the surface (thereby preventing the surface water from penetrating to depths beyond the reach of the plant roots) most of the arctic zone would be a lifeless desert.

In the Arctic the vegetation is much affected by the severe conditions under which plants must grow. The shortness of the growing season and the deficiency of soil and precipitation have a more marked effect on plant life than has the lowness of the air temperature.

Because of the absorption of heat by the dark-colored soil and its vegetation, the temperature of the surface soil and the air surrounding the growing plant may be as much as 25 or even 40 degrees F. higher than that of the air. In northern Greenland, during the month of May when the air temperature at noon was 10° F., a temperature of 38° F. was recorded among the dead leaves of a tuft of saxifrage and 50° F. inside a cushion of dark-colored mosses. Willow and

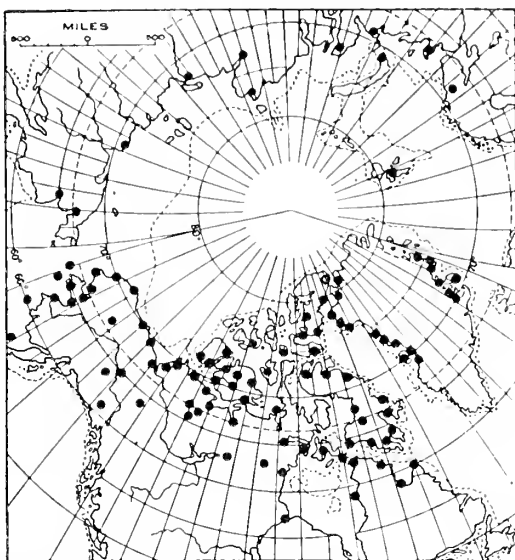
ground birch often grow espalierlike against a south-facing rock or cliff, where they obtain added heat when the sun warms the rock. Here we have the answer to the apparent enigma: How can plants in the Arctic grow and flower at air temperatures barely above freezing?

During unfavorable weather the growing parts of the plant may freeze but are not destroyed. In this manner the effective growing season of arctic plants is prolonged very considerably beyond the short period of days "without freezing temperatures" as recorded by the meteorologist. As yet plant physiologists have not been able to explain how, during the growing season, the cell protoplasm of arctic and alpine plants is able to survive the alternate freezing and thawing which would kill plants of temperate climates.

Plant life in the polar regions resembles that found in the high mountains of more southern latitudes; several life forms and a great many species are common to the arctic zone and to peaks more than a thousand miles to the south. Above timberline at Banff in the Canadian Rockies, in latitude 52° North, the flowering season is from July 1 to August 15. This period closely corresponds to that for most of the Arctic.

Owing to poor drainage and poor aeration arctic and subarctic soils are generally acid, and organic decay by bacterial action is extremely slow; consequently available nitrogen, as well as other salts needed by plants, is frequently deficient. In a few places in the Arctic—such as bird cliffs, animal burrows, and refuse heaps near human habitations—where nitrogen and phosphate are supplied, many arctic plants respond by lush and rank growth. Everywhere within the arctic zone, the subsoil is permanently frozen often to great depths. The annual thaw of the surface soil varies with its texture; in sand and gravel it may penetrate 8 feet; in wet, peaty soil, only a few inches.

Characteristic of the level tundra is stagnant water that results from poor drainage. For about a month each spring, the tundra is very wet because of the melt water. Frost action here causes the for-



Dots indicate approximate distribution of such circumpolar species as chickweed (*Stellaria humifusa*), buttercup (*Ranunculus pygmaeus*), saxifrage (*Saxifraga hirculus*), willow-herb (*Epilobium latifolium*), and bellflower (*Campanula uniflora*)

mation of a characteristic network of cracks, somewhat like the cracks of dried-up mud in the bottom of a summer-dry pond. As a result of the frozen soil the cracks and fissures remain water-filled throughout the summer. The sedge-covered, peaty hummocks are, in part, caused by frost cracks and frost heaving.

Characteristics of Arctic Plants

Almost all truly arctic plants are perennial: summer is too short for annual species to complete a life cycle in one season. Most species require many years from germination to the first flowering. Many do not depend entirely on seed production for their propagation but have various means of vegetative reproduction.

Many arctic plants are adapted to withstand prolonged drought by having rather small, often leathery leaves or by having their leaves and stems covered by densely matted hairs that provide a feltlike covering.

Arctic plants exhibit a truly remarkable hardness. On a late April day, east of Great Bear Lake, the temperature rose in a few hours from -30° F. to several



Fat catkins of the creeping arctic willow (*Salix arctica*) appear before the tundra is free of snow

degrees above freezing. Sixty hours later the water began to run in the creeks and the buds to swell on a clump of willow. The lower part of these 6-foot willows was buried in 3 feet of ice and snow, but the sap started to run in the parts protruding through the snow. After a week of thawing weather, the catkins were ready to expand. Then winter again set in, with temperatures down to zero. The willows froze solid and were covered with hoarfrost. The large buds, and even the smaller twigs, broke off like icicles at the slightest touch. The cold spell lasted nineteen days. Three weeks later, the snow was thawing rapidly. The willows had suffered but slightly. Some buds had been broken off, most likely during a gale that had blown for three days, but the rest resumed their flowering, apparently unaffected. The male catkins were fully expanded a few days later, and the females followed after an interlude of a few days. The leaves succeeded the flowers that a month later produced abundant and ripe seed.

One night late in July, when the temperature had dropped to 26° F., there were masses of the broad-leaved willow-herb (*Epilobium latifolium*) in full bloom on a flood plain in a Yukon mountain pass. At 4 a.m. the petals and even the leaves were frozen as stiff as wax flowers and were covered with tiny ice crystals. A few hours later, when the sun rose over the mountain range, the flowers thawed

and showed not the slightest sign of frost damage.

By their low and compact growth habit (cushion plants), arctic plants are well adapted to resist desiccation and mechanical abrasion by wind and by drifting snow and sand. The winter huds of many arctic plants are just below the surface of the soil, or just above the surface where they are protected by the persisting leaves of former years.

Vegetative propagation takes place in a number of ways: by adventitious buds in the leaf axils, by turions or offsets, by bulbils that become detached from the mother plant, and by widely creeping rootstocks. Because of widespread vegetative reproduction among arctic plants, small variations in the form and structure often are remarkably stable.

In common with some desert plants, many arctic species require a remarkably short time to awaken from winter dormancy, come to bloom, mature fruits, and prepare again for winter. The small, purple-flowered saxifrage (*Saxifraga oppositifolia*), the yellow whitlow-grass (*Draba alpina*), and the yellow arctic poppy (*Papaver radicum*) require only a month to commence growth, flower, and mature seed.

Spring comes with a rush in the Arctic. The snow disappears almost overnight; and long before the last drifts have entirely vanished, the first flowers put in an appearance. At the mouth of the

Arctic white-heather (*Cassiope tetragona*), important as a fuel plant for the Eskimos



Mackenzie Delta, the pasque-flower or "wild crocus" (*Pulsatilla ludoviciana*, or *Anemone patens*) began growth on May 15, when a thin crust of snow still covered last year's withered leaves. On May 25, when the ground had dried, the large bluish flowers appeared while the new foliage was still undeveloped. On June 25 some of the seeds had already been dropped.

Early in August most of the arctic plants have completed their seasonal life cycle. While the seeds are maturing, new leaf buds and flower buds develop near the surface of the soil, well hidden among the dead leaves, and food is stored up in the subterranean stem or in the root system, for next season's growth.

Dispersal

Important factors of plant migration:

1. Solid ice in winter bridges not only lakes and rivers but also very considerable expanses of sea—particularly straits and sounds separating islands.

2. Drifting snow levels rough spots on the sea ice and on the land surface, thereby facilitating the transportation of seed by the wind.

3. Winds of high velocity are more common in the Arctic than elsewhere.

4. A high percentage of arctic plants have relatively small and light seeds, and many are specially adapted for wind transportation.

5. Transportation by rivers and streams,

and particularly by melt water in spring. Each spring the north-flowing rivers of continental parts of the North American Arctic are loaded with driftwood and flotsam composed in part of plant remains and seeds that have accumulated on the ice of lakes and rivers during winter.

6. Ocean currents undoubtedly are responsible for the transportation and dispersal of many seashore plants.

7. Birds and mammals are important agents in the step-by-step dispersal of plants. Over a long period of years certain species may migrate in this manner. The ground squirrel, lemmings, and field mice feed on and store seeds of a number of species of plants. They also carry seeds which adhere to their fur. The burrows of ground squirrels and the dens of foxes and wolves are favorite habitats for some species. Foxes, ptarmigans, ravens, sea gulls, and geese feed on several species of berries and disperse the seeds.

The Arctic Flora in Relation to Man

Few plants native to the Arctic are of direct importance in the economy of man. None of the woody species are large enough for constructional use by the Eskimo, who at least formerly, obtained what wood he needed chiefly from driftwood.

Heather and berry bushes, willows, alder, and ground birch are used by the



Labrador-tea (*Ledum groenlandicum*), one of the plants adapted to withstand drought by having a felt-like covering on the underside of the leaves

Eskimo for cooking. Of greatest importance are crowberry (*Empetrum*) and the white-heather (*Cassiope tetragona*), both found almost everywhere in the Arctic. The white-heather is so rich in resin that it will burn even when moderately wet. Nearly all the larger lichens are highly inflammable when dry and may be used for fuel. Raw peat, particularly heath turf, but also partly decomposed sphagnum moss, is available nearly everywhere in the Arctic, and in Greenland provides an important source of fuel.

Indirectly the arctic vegetation is of great importance to man because nearly all sedges and grasses and many lichens, in addition to many herbaceous and woody plants, furnish food for grazing animals. Seeds, winter buds, and roots of many species are eaten by birds and small rodents that in turn constitute the food of some of the fur-bearing mammals. Likewise, the comparatively rich marine plant life indirectly furnishes food for the sea mammals so important in the economy of the Eskimo.

A small number of plants found in the Arctic are used for food by native and white inhabitants. Of greatest food value are the lichens, though none is used by natives. Black and gray lichens known as "rock tripe" grow on acid rocks throughout the Arctic. Together with Iceland-moss (*Cetraria islandica*) and reindeer-moss (*Cladonia*), they have been used regularly by arctic travelers, and on more than one occasion have saved the lives of field parties. Numerous species of edible mushrooms are found in the Arctic but are not used by natives. In Greenland and Baffin Island some green and red marine algae (sea-lettuce and dulse) are eaten by the natives in times of scarcity, and in Greenland the succulent young stalks of angelica and the leaves of sorrel (*Oxyria digyna*) are highly prized. In Alaska the leaves of a saxifrage (*Saxifraga punctata*), dock (*Rumex*) and the tubers of the Eskimo potato (*Claytonia tuberosa*) are commonly used. Several kinds of "berries" — including crowberry (*Empetrum*), cloudberry or baked-apple (*Rubus Chamæmorus*), and hog bilberry (*Vaccinium uliginosum*), when available are used by all Eskimos.

Problems in Arctic Botany

Although the flora of Greenland has been studied longer and more intensely than that of any other arctic country, it still presents some very puzzling and unexplained problems. Considering the vast extent of the Greenland coastline, its flora (about 422 species of flowering plants) is not large.

Until the advent of the aeroplane, practically all botanical exploration in arctic and subarctic parts of North America had been limited to regions accessible by river or sea transportation. Vast areas in the heart of the continent and most of the mountain systems still await exploration. In spite of the more intensive exploratory work of the last decades, these regions, botanically speaking, still remain among the least known in the world.

METASEQUOIA BROUGHT UP TO DATE

*Culture notes on the recently
discovered dawn redwood*

Donald Wyman

Condensed from *Arnoldia*, April 27, 1951.

THE history of the discovery of *Metasequoia glyptostroboides* has been retold several times.* To Chinese botanists goes the full credit for the discovery of this heretofore "extinct" species. Dr. E. D. Merrill and the Arnold Arboretum should be given credit for the introduction of this species into modern gardens.

Many articles have appeared concerning this tree. The best bibliography of these to date appears in "An Ecological Reconnaissance in the Native Home of *Metasequoia glyptostroboides*," by Kwei-ling Chu and William S. Cooper, in *Ecology*, April, 1950.

Metasequoia has exhibited very fast growth. A 28-month-old specimen has grown 8 feet from seed in England. Specimens in this country may not have grown quite so fast, although one plant in the Santa Barbara Botanic Garden grew 5 feet in one year.

Requests keep coming in for more information concerning this tree. A few points of practical interest may help to bring many up to date.

Climate of Native Habitat

At first it was thought that this species might not be hardy north of Georgia. The climate of the coastal plain in Georgia is very similar to that of the native habitat of this tree. Recent investigations

have shown that it is growing in a small section of Szechuan and Hupeh provinces in China (near Chungking) where the annual rainfall amounts to about 48 inches, rather evenly distributed throughout the year. Here also very little snow falls. Temperatures on the average apparently do not go much below freezing. Just why this species should be confined to this small area of not over 300 square miles will make a most interesting story when all the facts are known.

The atmosphere in this area is reasonably moist; and several tests show the soils to be about neutral to only slightly acid. Apparently no accurate records are available on the lower temperatures in the winter, and summer temperatures are not supposed to average over 100° F. The tree has been found to be reseeding itself in moist ravines, in what might be considered the same kind of places where we would expect hemlocks to reseed themselves in this country.

Hardiness in this Country

Since its introduction, it has been living out of doors unprotected in several places on the Pacific Coast. In the East it has survived in Washington, D. C., Philadelphia, New York, and Boston, living out of doors uninjured the last three winters without protection. Reports are not yet all available, and many seeds and plants have been distributed; and so some may have been injured within this area. These three winters have been comparatively mild ones, and no prolonged sub-zero weather has occurred. It would be advisable not to become too enthusiastic concerning the hardiness of this species, certainly not until we see what happens

*For example, in *Plants & Gardens*, Winter, 1948.—Ed.



Metasequoia in the Arnold Arboretum. Seed sown in July, 1948. Transplanted to this spot in the spring of 1951, when it was height indicated by girl's hand. By September, 1951, it had grown 4 feet 4 inches—had doubled its height since transplanted

Courtesy
Arnold Arboretum

to older trees in unusually cold winters.

Many variable factors like soil, rainfall, high temperatures, low temperatures, exposure, and length of growing season affect the hardiness of a plant. In the case of a new plant, where climatic records of its habitat are meagre (as in this case), one should proceed slowly in drawing conclusions concerning its hardiness on the basis of three mild winters only. Chu and Cooper found the following

plants native to the same location as *Metasequoia*. All of these are hardy in the Arnold Arboretum.

three-leaf akebia (*Akebia trifoliata*)

Boston-ivy (*Parthenocissus tricuspidata*)

Chinese buckthorn (*Rhamnus utilis*)

Decaisnea fargesii

dogwood (*Cornus controversa*)

helwingia (*Helwingia japonica*)

Japanese honeysuckle (*Lonicera japonica*)

Idesia polycarpa
Kalopanax pictus

Katsura-tree (*Cercidiphyllum japonicum*
sinense)

white mulberry (*Morus alba*)

oriental oak (*Quercus variabilis*)

sawtooth oak (*Quercus acutissima*)

rock spray (*Cotoneaster horizontalis*)

shrub-althea (*Hibiscus syriacus*)

Japanese snowbell (*Styrax japonica*)

winged spindle-tree (*Euonymus alata*)

Japanese spirea (*Spiraea japonica*)

tea viburnum (*Viburnum setigerum*)

winter-hazel (*Corylopsis sinensis*)

However, the following plants are also growing in the same location. These are not hardy in the Arnold Arboretum.

Chinese actinidia (*Actinidia chinensis*)

Camellia oleifera

common china-fir (*Cunninghamia*

lanceolata)

David false panax (*Nothopanax davidi*)

Ficus heteromorpha

privet honeysuckle (*Lonicera pileata*)

Formosa sweet gum (*Liquidambar*

formosana)

Chinese tupelo (*Nyssa sinensis*)



Courtesy Mrs. R. E. Blum

Metasequoia 2½ years from seed in R. E. Blum garden on Long Island. (The largest *Metasequoia* on Long Island is in the Frank Bailey garden; it was 3 years old and 16 feet tall in October, 1951)

The tallest specimens of *Metasequoia* in China are about 100 feet high. Estimates have been made from borings in the trunk that some of these trees may be 300 years old. It is a rapid-growing tree, certainly while young; but apparently everyone growing it in America has given it optimum growing conditions. The wood is rather brittle, and is not apparently used for any special purpose except for fuel, by the natives in the vicinity of the native stands in China. It apparently grows best in a moist atmosphere, with soils that contain a good deal of moisture. It is loose and open in habit, and may be best suited for growing in groves rather than as individual specimens, although many in this country, at least, will grow it for a long time as single specimens.

This species is not an evergreen and in this respect it is certainly not like the giant redwoods of our Pacific Coast. It is deciduous, and in its native habitat does not grow to the great size and age of our native redwoods.

Propagation and Sources

It is easily propagated by cuttings. There are a sufficient number of plants growing in America now, so that even though the seed source may be cut off, commercial propagation of this plant can easily be worked up to supply the demand in a short time. Either softwood or hardwood cuttings root readily. Although many nurserymen have it in America, there are three, at least, who already list it as available in their catalogues. These are:

Rare Plant Club, 208 McAllister Avenue, Kentfield, California

Tingle Nursery, Pittsville, Maryland

Verhalen Nursery Company, Scottsville, Texas

HOW OLD ARE THE MANCHURIAN LOTUS SEEDS?

*Geologist, botanist, and chemist
cooperate in search of the answer*

Ralph W. Chaney

Condensed from *The Garden Journal*,
Sept.-Oct., 1951

DESIRE for earthly immortality is implied in such legends as the search by Ponce de Leon for the fountain of youth. The idea of suspended activity is expressed in stories of the Sleeping Beauty and Rip Van Winkle; perhaps this idea had its origin in the ability of certain seeds to remain viable (alive) for many years without showing any sign of life, and later to grow when

favorable circumstances arose. There are many legends regarding the viability of seeds over long periods, all of them open to grave question.

Now comes the strange story of lotus seeds from a lake deposit in Manchuria, seeds which grow readily and produce strong plants after a period of inactivity to be measured in tens of thousands of years. Is this merely another legend or are the lotus plants recently germinated at our National Capital the oldest living things?

Geology

The geologist has an answer, based on the sequence of events recorded by the rocks and topography of the Pulantien Basin of southern Manchuria where the seeds were discovered:

In a lake about a mile across, there accumulated a layer of plant fragments—leaves, stems, roots—which disintegrated to form a deposit known as peat. In this were buried thousands of seeds of a water-lily similar to the Indian lotus. Because of their thick walls, few if any of these seeds germinated. Geologists estimate that it normally requires many years for plant fragments to accumulate and become compacted to form even an inch of peat; so it may be supposed that lotuses lived in this Manchurian lake and dropped their seeds and other structures to its bottom over a period of several centuries.

At some later time, the lake was drained, and the peat was exposed to the atmosphere; several feet of dust from arid areas (a fine wind-borne clay known



Flower of modern Indian lotus

Published by The New York Botanical Garden, Bronx Park, New York 58, N. Y.

as loess) was deposited on the lake beds in which the lotus seeds were buried. It is impossible to determine how the lake disappeared, but it is reasonable to suggest that the plain on which it lay was uplifted; for the Pulantien River has cut down through the underlying layer of peat, and to a depth of more than 40 feet into the bedrock below. The peat bed, now exposed on the valley walls, is all that remains to tell us of the lake which occupied the Pulantien Basin in times past.

Accumulation of the peat in which the lotus seeds are embedded, probable uplift of the region several tens of feet, deposition of the loess, cutting of a valley 40 feet deep—all this involves time to be measured not in decades or centuries, but in thousands of years. There is no possibility that the seeds were later introduced into the peat bed through gopher holes or some other openings from the surface, for they are far too abundant. Dr. Seido Endo, professor of geology and paleontology at Tohoku University in Sendai, Japan, believes that the peat was deposited fifty thousand years ago, together with the seeds contained in it.

Geography

There is another line of evidence suggesting great antiquity for these lotus seeds. This plant is no longer a native of northeastern Asia. Its present range does not carry it further north than southern China, fully a thousand miles to the south. (In North America many trees have shifted their area of occurrence for hundreds of miles as a result of climatic changes.)

Botany

A third factor appears effectively to dispose of the possibility that man may have brought to Manchuria the lotus plants which produced our seeds. These seeds are smaller, more elongate, and darker in color than those of the modern Indian lotus. These differences indicate a lapse of time during which the seeds of the lotus have undergone evo-

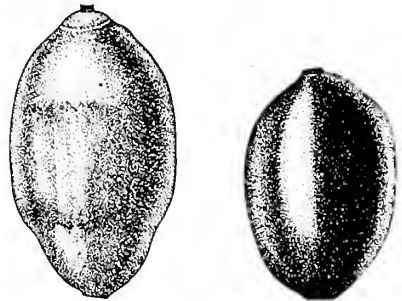
lutionary change. The combined botanical, geographic, and geological evidence therefore indicates great antiquity for the lotus seeds which germinated in Washington and in Berkeley last March.

History

The first statement regarding their occurrence which I have seen was in 1923 by the Japanese botanist, Ichiro Ohga. He wrote a series of papers describing their structure and germination. He estimated their probable age as "at least three or four hundred years." He gave seeds to various institutions in the United States.

During my visit to Sendai, Dr. Endo was kind enough to give me three of these seeds. Two of them were turned over to Horace V. Wester at Kenilworth Aquatic Gardens, Capital National Parks, Washington, D. C. The seeds germinated. An account of Dr. Wester's procedure has been published in the *Bulletin of the Garden Club of America* for May, 1951.

The third seed was taken to the Botanical Garden of the University of California in Berkeley. Under the care of Harry K. Roberts, it was soaked in concentrated sulphuric acid for three hours, then thoroughly washed and placed in a beaker of water; within an hour cracks began to appear on its shell as entering moisture caused the embryo to expand;



Walter L. Graham, courtesy N.Y. Botanical Garden

Left, seed of modern Indian lotus;
right, ancient Manchurian seed

less than two days later, a green shoot appeared and rapidly elongated. So far, we had equaled the success of Dr. Wester, who employed the method of filing the seed coats as outlined by Ohga. But part of our seed broke and became infected with fungus; within a few days it showed no further sign of life. However, the Washington seedlings have continued to thrive; but we shall have to wait for several years before these lotus plants bloom.

Age

In the meantime, there is the important matter of their age to consider. Rumors of antiquity involving several thousand years, in the case of wheat from the Pyramids of Egypt, have been shown to be incorrect.¹

Several tests have been carried on with seeds placed in containers beneath the surface. Beal's experiment was begun in 1879 with twenty kinds of seeds, only ten of which germinated forty years later.

Duval's experiment, with 107 kinds of buried seeds, showed that not more than thirty-six species were viable after thirty-nine years. Molisch believes that only seeds with thick shells, making them impervious to water and air, may survive as long as fifty to eighty years.

¹Bearing on this very point is a manuscript letter recently given to the Brooklyn Botanic Garden by Mrs. Lewis W. Francis of the Garden's Governing Committee—a letter from the famous botanist Asa Gray. The letter is dated September 1, 1882, from the Herbarium of Harvard University, Botanic Garden, Cambridge, Massachusetts. Its text reads:

“Dear Master Farrington

I was away from home till now, so your letter to me has not been answered

The stories about seed from hand of mummies are told with much particularity. But some of them show deception or mistake on examination; not a single case I know of bears critical examination: the really old seeds we know have undergone a change like parching, & in short I don't believe any seed 2000 years old—or 1000—ever germinated.

Truly yours
Asa Gray”

Ohga cites a modern lotus seed, which germinated after an interval of more than 150 years. To my knowledge this is the oldest record and it is significant that a lotus seed is involved. It is the thick shell of this lotus seed which appears to be responsible both for delaying germination and for the retention of life in the embryo within. Who can say that with such a protective covering any seed might not retain its viability indefinitely?

Chemistry

The question of the age of seeds may eventually be solved by a chemist. Dr. W. F. Libby of the University of Chicago has learned that a substance known as Carbon-14 (contained in all living matter) is gradually dissipated and that at the end of 20,000 years, no trace of it can be found. Since its loss is at a constant rate, he has been able to develop a method of dating based on the amount of Carbon-14 remaining in material. To apply this method it is necessary to have an amount equal in this case to twenty lotus seeds.

There are doubtless thousands of lotus seeds still in the peat bed at Pulantien, but there seems to be no way to get them out of Red China. However, at the National Museum, Dr. Roland W. Brown generously turned over two seeds to me; at the New York Botanical Garden, I found four more. I have hopes that some may be found at other institutions in America; and Dr. Endo is sending me several. Perhaps the question may soon be resolved by Dr. Libby.

Preliminary tests by Dr. Libby indicate that the seeds have a minimum age of 1,000 years. It is hoped that more seeds can be secured, so that a test can be run using only their shells, and that some of the peat in which they were buried may also be tested. With this information, the maximum age of the seeds may be established. Only then shall we be able to say with assurance that these are fossil seeds, representing the greatest known prolongation of life from remote antiquity.

DR. BEAL'S SEED VIABILITY EXPERIMENT

The seventy-year period of testing how long some common seeds can remain alive — under conditions unfavorable for growth — and still be able to germinate in a suitable environment

H. T. Darlington

Condensed from *American Journal of Botany*, April, 1941 and May, 1951

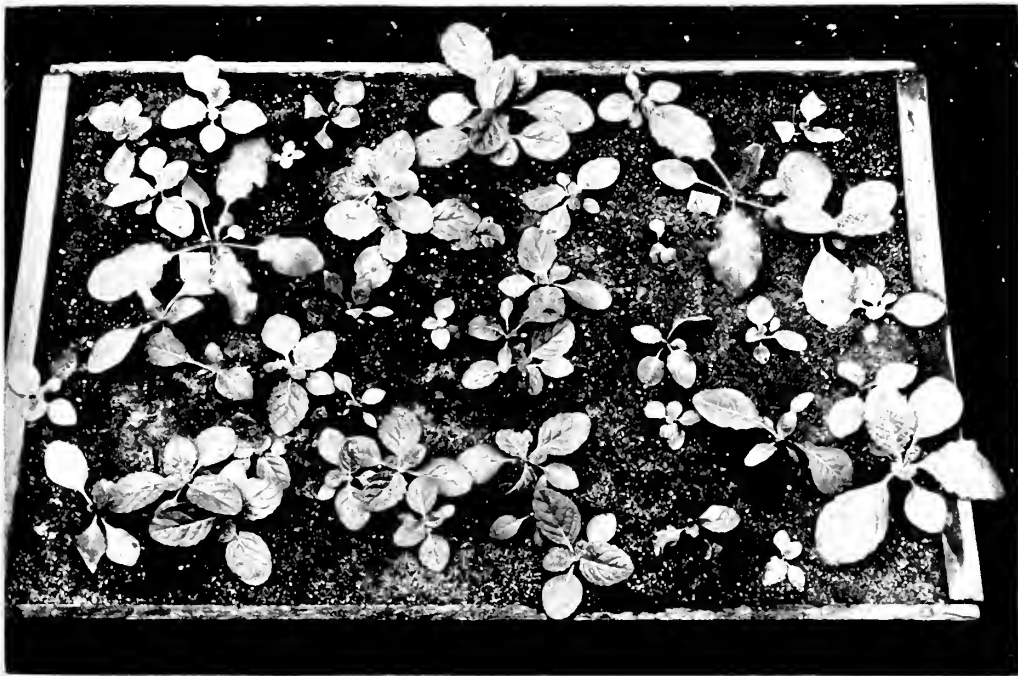
DURING the fall of 1879, Dr. W. J. Beal, at that time Professor of Bot-

any at the Michigan Agricultural College (now Michigan State College), began an experiment to determine the viability of the seeds of a number of plants (mostly weeds) growing in the vicinity of the college. The seeds were thoroughly mixed with sand. Twenty pint bottles were filled with the sand and placed approximately 18 inches below the surface of the ground. Fifty freshly gathered seeds from each of twenty different herbaceous plants, or a total of 1000 seeds, were put in each bottle.

Dr. Beal's original plan was to dig up a bottle every five years and test for

Seedlings six weeks after seeds were planted

Author courtesy



Published by the Botanical Society of America, Inc.

germination. This plan was carried out up to 1920. It was then suggested that the duration of the experiment be increased by changing the interval to ten years. This was done, and the eleventh bottle was taken up during the afternoon of March 24, 1950. The contents were transferred without delay to a flat

in which the soil had been sterilized. The experiment was conducted under ordinary greenhouse conditions.

The seedlings that appeared included three species, identified as *Verbascum blattaria* [moth mullein], *Rumex crispus* [yellow dock], and *Oenothera biennis* [evening-primrose].

The table below shows the number of individuals and percentage germination of each, in 1940 and 1950.

Name of plant	Number of individuals		Percentage of germination	
	1940	1950	1940	1950
yellow dock	2	4	4	8
evening-primrose	12	7	24	14
moth mullein	34	36	68	72

The forty-seven seedlings of the 1950 test indicate an over-all percentage germination of 4.8. Percentages for 1920, 1930, and 1940 have been 8.2, 8.8, and 5.6 respectively.

The table below is a [condensed] record of the tests up to 1950; it indicates only the number of times each species has produced at least one seedling.

Name of species tested	5th yr. 1884	15th yr. 1894	25th yr. 1904	40th yr. 1920	50th yr. 1930	60th yr. 1940	70th yr. 1950
shepherd's purse (<i>Bursa</i> —or <i>Capsella</i> — <i>bursa-pastoris</i>)	+	+	+	—	—	—	—
peppergrass (<i>Lepidium virginicum</i>)	+	+	+	+	—	—	—
common mallow (<i>Malva rotundifolia</i> — or <i>neglecta</i>)	+	—	—	—	—	—	—
common evening-primrose (<i>Oenothera</i> <i>biennis</i>)	+	+	+	+	+	+	+
common plantain (<i>Plantago major</i>)	—	+	—	+	—	—	—
common purslane (<i>Portulaca oleracea</i>)	—	+	+	+	—	—	—
yellow dock (<i>Rumex crispus</i>)	+	+	+	+	+	+	+
white clover (<i>Trifolium repens</i>)	—	—	—	—	—	—	—
common mullein (<i>Verbascum thapsus</i>)	+	+	—	—	—	—	—
moth mullein (<i>Verbascum blattaria</i>)					+	+	+

LIVING BEAUTY WITHIN SCHOOL WALLS

Developed chiefly by the students

Ruth E. Mathews

Condensed from *The National Gardener*,
March-April, 1951

IF you drive through Lexington, Kentucky, on U. S. Highway 25, you will pass a handsome schoolhouse such as might be found in any forward-looking community in America. Walk around the building, and there is nothing unusual to catch your eye, but step through the doorway, across a hall, and down a few steps, and enter such a beauty spot as you will find duplicated rarely, if at all, in another public school in the country.

Here, on the hottest midsummer day, not out of earshot of the horns of traffic, is a little world of shade, enclosed by ivy-covered walls. It has a quiet pool with water-lilies, scarlet berries of the high-bush cranberry, butterflies hovering about the butterfly-bush, pink and white althea, the whistle of the cardinal, all in a mass of green loveliness.

How did this come about? New rooms were added to our school building, enclosing two areas roughly 65 by 75 feet: a dreary picture at first, the ground a sea of mud and cast-off bricks, the walls at various points two or three stories high.

Miss Ella C. Williams, teacher of biol-

ogy at Henry Clay High School, suggested to her students the possibilities for development that these unlovely spots offered. With her encouragement and direction the Bozo Club—organized some years before by students of bot-

Pool designed, built, and planted
ed by high school students

Author courtesy



Published by The National Council of State Garden Clubs, Inc., 160 Central Park South,
New York 19, N. Y.

any and zoology—undertook the task of making the two courts into gardens.

First they worked at clearing the space of debris. A pool, designed in the shape of the map of Kentucky, was dug by the members, and concreted by funds secured jointly from dues and from the Board of Education.

Chiefly, however, the work has been planting and caring for flowers and flowering shrubs, and keeping the pool clean and stocked with fish and turtles. A bird bath, sundial, trellis, and benches have been added. Student committees trim the vines and repaint the furniture.

Various experiments in keeping live animals have been tried. Well-adapted permanent residents are tortoises and snakes, besides the goldfish.

By careful choice in planting and arrangement, the flowers have provided a succession of color, from the silver gray

of the pussy willows to the orange of cosmos, followed by tall hardy asters and chrysanthemums.

After an ambitious start the Bozo Club decided to concentrate its efforts on east court, and west court was turned over to our librarian, Miss Susan Miller. In lieu of the dues of club members, Miss Miller financed west court by library fines collected from overdue books at two cents per day. East court and west court are quite different: the one marked by activity and variety, the other by more formal quiet beauty.

As the courts have become beauty spots, their use is never limited to the persons who care for them, but they offer color and charm for all to enjoy. No one can say how many homes and gardens in Lexington may have been made more beautiful, or how many lives enriched, from the experience the boys and girls have gained here at school.



Photos courtesy Indiana University

School children of Bloomington, Indiana, help "Plant America," through community project

CHILDREN GROW IN GARDENS

Basic philosophy of a cooperative project

Barbara Shalucha

Condensed from *The National Gardener*,
July-Aug., 1951

SCORES of "green kingdoms," side by side, and within them 150 boys

and girls, happy kings and queens of these plots of good earth. This is a community project, supported by the city department of recreation [Bloomington, Indiana], Indiana University, and the Bloomington Garden Club; it enables the city to feature gardening as a leisure-time program for its school children in spring and summer, and the university to offer its students experience for similar responsibilities in their vocations.

Published by the National Council of State Garden Clubs, Inc., 160 Central Park South, New York 19, N. Y.



Indoor view of school children drawing plans for their gardens, under supervision of university student teacher

The Student Teacher

Our pattern is simple and flexible. The student garden teacher is aware that the foundation of any junior garden is his leadership and that this rests upon his being prepared for each lesson; that knowing his subject is not enough, and that he must like working with young people.

Outdoor gardening begins late in March for the university students. On Planting Day, in late April, the garden teachers introduce garden principles to the junior gardeners by using a pattern, their own plots.

Garden teachers are trained in service. They are in complete charge of their groups of young gardeners throughout the spring. Once a week they meet to share experiences and to review the next lesson.

The Young Gardeners

Garden time is announced through the school system in March. Boys and girls between 9 and 12 years of age may become members of this Junior Garden Workshop. Membership may be renewed annually until graduation from high school.

Every activity for our boys and girls provides for the development of responsibility, appreciation of work, and growth in character. One of the most important lessons a junior gardener learns in this program is to think before he goes into action. When drawing up garden plans, the garden teachers hear "Oh—I want to plant lots of carrots, beets—oh, and hundreds of everything!" Soon they direct these big ideas on paper, and then with careful guidance the hundreds of everything become discarded; this lesson is recorded on paper simply and clearly in the form of a garden plan; it continues with the eventual plan in action during planting time. By the end of the season the realization that the plan did work is a rich experience for the young gardener and for the instructor who has watched the mental development of the child.

On Saturdays when it is impossible to

be out in the garden, the indoor lessons continue just as interesting as the outdoor ones because the leaders draw upon the young gardeners' imagination, making scientific facts important.

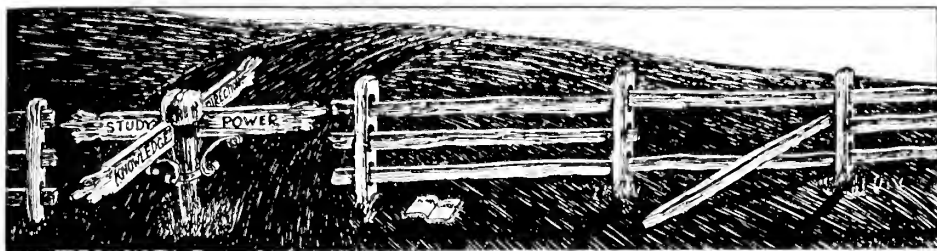
With school out, the gardening program assumes an important role in the child's life and in the well-being of the community. Under four student directors, and guided by those responsible for the Workshop, the program swings into action with gardening twice a week and nature study every Saturday morning. The garden periods are devoted either to the care of the vegetable plots or to the fulfillment of requirements in the Honor Work Plan.

Under the Honor Work Plan, the gardener is initiated into many activities in the gardens. The flower border holds several favorites. The herb garden has given opportunity to take home herbs. The gardener has discovered that it is fun to help weed other people's gardens when they are away on their vacations. The garden program is concluded with the awarding of honors at a special ceremony.

The Harvest

How rich are the harvests for the junior gardener? From his garden plot, 10 by 10 feet, he supplied food for home use. He has learned to prepare soil for planting; how to fertilize the garden; how to make and interpret a garden plan; how to cultivate and why; how to thin and why; how to spray and for what bug or disease; how to care for his tools. Most important, he has done it with other boys and girls, sharing the fun and working together.

The students who have directed this program leave with a working knowledge of the program, and have been introduced to many different ways of getting along with people, young and old. This small band of garden club women reaps rich harvests in the knowledge that wherever youngsters wish to be "kings of green kingdoms" there will be trained leaders who share in our basic philosophy that *Children Grow in Gardens*.



WORTH READING

A SELECTED LIST OF RECENT NONTECHNICAL BOOKS, MAGAZINE ARTICLES,
AND EXPERIMENT STATION BULLETINS

General

FARMING AND GARDENING IN THE BIBLE, by Alastair I. MacKay. Published by Rodale Press, Emmaus, Pa., 1950. 280 pages. \$3.

Quotations and retold tales referring to plants and their culture, classified according to the kinds of plants.

PIONEER AMERICAN GARDENING, compiled by Elvenia Slosson. Published by Coward-McCann, New York, 1951. 322 pages. \$3.75.

A collection of stories from America's horticultural history, from forty-one different states.

JOHN BURROUGHS' AMERICA, edited by Farida A. Wiley. Published by Devin-Adair, New York, 1951. 320 pages. \$4.

The cream of the writings of this great naturalist: examples of the timeless, the universal, and the most readable passages.

NORTH WITH THE SPRING, by Edwin Way Teale. Published by Dodd, Mead, New York, 1951. 384 pages. \$5.

A 17,000-mile, 130-day trip from the Everglades to Canada, through twenty-three states, to watch the plants and animals.

THE FERTILIZATION OF FLOWERS, by Verne Grant. In *Scientific American*, June, 1951. 4 pages.

Color, odor, and form of flowers in relation to bees, moths, flies, butterflies, beetles, birds, bats, wind. Drawings.

BIRD GUIDE, land birds east of the Rockies, revised edition, by Chester A. Reed. Published by Doubleday, Garden City, N. Y., 1951. 240 pages. \$1.50 and \$1.95.

Descriptions, and illustrations in color, of over 200 species; notes on song, nest, range; color key for identification; pocket size.

Lawns

HOW TO GROW AND KEEP A BETTER LAWN, by Joseph F. Flynn. Published by Simon and Schuster, New York, 1951. 89 pages. \$1.

Based on twenty-two years of professional grass growing; the established lawn; the new lawn; special problems; drawings.

TURF MANAGEMENT, by H. Burton Musser. Published by McGraw-Hill, New York, 1950. 361 pages. \$6.

Practical guide to the development and maintenance of turfs and other lawns; for homeowners as well as keepers of public greens. New information. Fertilizers, drainage and irrigation, weed and insect control, variety of grass for type of soil,

how to sow and care for different kinds of grass seeds. Photographs and drawings.

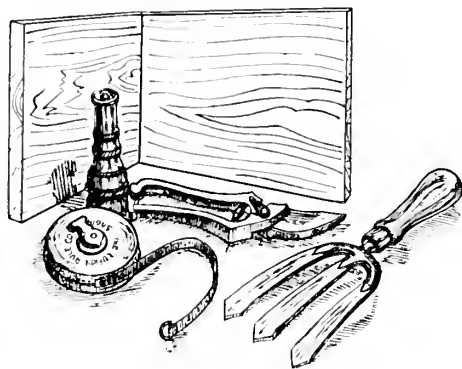
YOUR LAWN, by Geoffrey S. Cornish. Published by Authentic Publications, New York, 1951. 48 pages. 50 cents.

A guide for homeowners who wish to have better lawns with minimum expenditure of time, money, and energy. Drawings.

LAWN PLANTING AND CARE, by H. M. Butterfield and others. University of California Agricultural Extension Circular 181. Oct., 1951. 38 pages.

Landscape, seed bed, irrigation, selection of seeds, methods of planting, maintenance, diseases, pests, weeds, renovating.

Gardening and Landscaping



COLOR AND DESIGN FOR EVERY GARDEN, by H. Stuart Orloff and Henry B. Raymore. Published by Barrows, New York, 1951. 301 pages. \$3.50.

Written by professionals for amateurs. Planning, plant arrangement, plan for succession, gardens for special situations, regional plantings, plants for special purposes, blooming times. Drawings.

BORDER PLANTINGS AND OUTDOOR LIVING ROOMS, by Donald J. Bushey. Cornell University (Ithaca, N. Y.) Extension Bulletin 813. June, 1951. 30 pages.

Lawn: front, side, rear; urban, rural. Service areas. Grading. Hedges, vines, ground covers, shrubs of various sizes, small trees.

HOW MUCH FERTILIZER SHALL I USE? by Charles E. Kellogg. U. S. Department of Agriculture Leaflet No. 307. April, 1951. 6 pages. 5 cents.

A gardener's guide for converting tons or pounds per acre into cups or spoonfuls per row or plant.

SUMMER CARE OF THE GARDEN, by C. B. Raymond and others. Cornell University (Ithaca, N. Y.) Extension Bulletin 832. June, 1951. 16 pages.

Vegetables, small fruits, flowers, lawn; small-animal damage, diseases, insects.

PRUNING ORNAMENTAL PLANTS, by L. R. Detjen. University of Delaware (Newark) Agricultural Extension Bulletin 52. Jan., 1951. 16 pages.

Reasons, seasons, methods, design.

THE HOW AND WHY OF BETTER GARDENING, by Laurence Manning. Published by Van Nostrand, New York, 1951. 248 pages. \$3.

What the gardener needs to know, to understand the effect of environment on plants and to make proper use of their functions. Climate and what to do about it; soil and how to help it; leaves, stems, roots, flowers, and seeds, and what they do and how to work intelligently with them.

LANDSCAPE ARCHITECTURE, edited by Lester Collins and Thomas Gillespie. Published by the Department of Landscape Architecture, Graduate School of Design, Robinson Hall, Harvard University, Cambridge, Mass., 1951. 76 pages. \$2.

A few essays on the subject, and photographs of selected material from a recent exhibition by the Harvard Department of Landscape Architecture.

BUILDING PLANT SHELTERS AND GARDEN WORK CENTERS, ideas compiled from *Sunset Magazine*. Published by Lane, Menlo Park, Calif., 1951. 78 pages. \$1.

Lath-houses, greenhouses, hot and cold frames, propagating cases, miniature and folding shelters, workshop, storage and compost bins; photographs and drawings.

Annuals, Perennials, and Bulbs

HARDY CHRYSANTHEMUM CULTIVATION, by N. Gerard Smith. Published by Faber and Faber, London, 1951. 135 pages. \$1.75.

For amateurs. Soil, propagation, summer management, growing in pots, winter storage, pests and diseases.

ANNUAL FLOWERS, and HERBACEOUS PERENNIALS, by John V. Watkins. University of Florida (Gainesville) Agricultural Extension Bulletins 133 and 146. Oct., 1950 and Jan., 1951. 80 pages.

Selection, propagation, culture, lists for special situations and uses.

PENSTEMONS, by Grace F. Babb, Alida Livingston, and others. In *The National Horticultural Magazine*, Jan., 1951. 82 pages.

Classification, collecting, history, hybrids, regional reports.

THE NEW BOOK OF LILIES, by Jan de Graaff. Published by Barrows, New York, 1951. 188 pages. \$3.50.

By an expert, for amateurs and professionals; origin and culture of more than 200 varieties; propagation, hybridization, diseases, indoor and outdoor growing. Photographs in color, and drawings.



TREES FOR AMERICAN GARDENS, by Donald Wyman. Published by Macmillan, New York, 1951. 383 pages. \$7.50.

For the layman and the professional landscapist; descriptions of 745 kinds for various situations and uses: for shade, moist or dry places, seashore, city gardens, streets; for desired size or shape, for resistance to pests, for ornamental flowers, fruits, foliage, or bark. Information on hardiness and order of bloom. Keys, drawings, photographs, maps.

FLOWERING TREES OF THE CARIBBEAN, by Paul Knapp and Bernard and Harriet Pertchik. Published by Rinehart, New York, 1951. 137 pages. \$10.

Descriptions, folklore, and full-page illustrations in color, of twenty-nine kinds.

SMALLER STREET TREES NEEDED, by Donald Wyman. *Arnoldia*, June 8, 1951. 8 pages.

Why; kinds and sizes, and how to plant them.

THE PROPAGATION OF GINKGO BILOBA FROM CUTTINGS, by H. Tenschler. In *Parks and Recreation*, Jan., 1951. 1 page.

To get male trees for street planting and avoid the objectionable fruits.

NEW RHODODENDRONS, by David G. Leach. In *The Home Garden*, April, 1951. 6 pages.

British and American hybrids, many of them surprisingly hardy.

REDISCOVERING AMERICAN AZALEAS, by David G. Leach. In *The Home Garden*, Nov., 1951. 6 pages.

Some that all gardeners should know.

Economic Plants

CROPS IN PEACE AND WAR: the yearbook of agriculture, edited by Alfred Stefferud. Published by the United States Government Printing Office, Washington, D. C., 1951. 960 pages. \$2.50.

The uses of agricultural products and residues for food, feed, fabrics, fuel, leather, paper, paint, drugs, cosmetics, vitamins, lubricants, adhesives, upholstery, tannin.

ORNAMENTAL HEDGES FOR THE CENTRAL GREAT PLAINS, by A. C. Hildreth. U. S. Department of Agriculture Farmers' Bulletin 2019, Oct., 1950. 25 pages. 10 cents.

Instructions for establishment and care; evaluation of eighty-three kinds.

ORNAMENTAL SHRUBS FOR THE SOUTHERN GREAT PLAINS, by E. W. Johnson. U. S. Department of Agriculture Farmers' Bulletin 2025, Feb., 1951. 62 pages. 20 cents.

Size, form, use, propagation, and behavior of many kinds tested.

SUCCESSFUL ROSE CULTURE, by Glenn O. Randall and others. North Carolina State College (Raleigh) Agricultural Extension Circular 200 (revised). Jan., 1951. 24 pages.

Location and soil; time and method of planting; fertilization, cultivation, propagation, pruning, disease and insect control, choice of varieties.

WHERE DO WE STAND ON FALL PLANTING? by R. C. Allen. In *American Rose Magazine*, Oct., 1951. 4 pages.

Answers to some questions on dormancy; experiments to determine root growth.

CAMELLIAS, KINDS AND CULTURE, by H. Harold Hume. Published by Macmillan, New York, 1951. 283 pages. \$6.

Latest information on classification and methods of growing, by an authority. Photographs in black and white and in color, and drawings.

THE HYDRANGEAS, by Michael Hawthorth-Booth. Published by Constable, London (Macmillan, New York agent), 1950. 193 pages. \$4.75.

For the gardener. History, species and varieties, breeding, propagation, diseases and pests, culture in the garden and in tubs or pots.

PLAY WITH VINES, by Millicent E. Selsam. Published by Morrow, New York, 1951. 64 pages. \$2.

Drawings and suggested experiments to show how different kinds of vines climb and cling.

BREEDING IMPROVED HORTICULTURAL PLANTS: I, vegetables; II, fruits, nuts, and ornamentals, by A. F. Yeager. University of New Hampshire (Durham) Agricultural Experiment Station Bulletins 380 and 383. April and June, 1950. 39 pages.

For earliness, hardiness, disease resistance, productiveness, stature, nutritive value, flavor, color, size.

CULINARY HERBS, by W. C. Muen-scher, Myron A. Rice, and Babette I. Brown. Cornell University (Ithaca, New York) Extension Bulletin 841. Oct., 1951. 12 pages.

Common kinds and how to grow, propa-gate, harvest, dry, store, and use them.

THE ART OF COOKING WITH HERBS AND SPICES, by Milo Miloradovich. Pub-lished by Doubleday, Garden City, New York, 1951. 320 pages. \$2.95.

What herbs and spices are, where and in what forms they can be bought, how they may be used, and what their food values are.

THE MOLDS AND MAN, by Clyde M. Christensen. Published by University of Minnesota Press, Minneapolis, 1951. 252 pages. \$4.

An introduction to the fungi: how they live and reproduce and how they affect other plants and animals, harmfully and beneficially. Delightful reading.

HOW FRUIT CAME TO AMERICA, by J. R. Magness. In *The National Geographic Magazine*, Sept., 1951. 53 pages.

History of about thirty kinds; 24 full-page illustrations in color.

SEAWEEDS AND THEIR USES, by V. J. Chapman. Published by Methuen, Lon-don, 1950. 321 pages. \$3.60.

Occurrence and distribution; uses in in-dustry and in medicine, and as food for animals and for men.

NATURAL DYES, by Sallie Pease Kier-stead. Published by Bruce Humphries, Boston, 1950. 104 pages. \$2.75.

What plants to use and how to make the dyes and set the colors. Photographs and drawings.

PERFUME ALBUM, by Jill Jessee. Published by Perfume Productions Press, New York, 1951. 192 pages. \$3.50.

Use of flowers, grasses, spices, herbs, citrus products, wood, leaves, roots, gums, balsams, lichen, and animal products.

Native Plants



SAVING EARTH'S OLDEST LIVING THINGS, by Andrew H. Brown. In *The National Geographic Magazine*, May, 1951. 17 pages.

The giant sequoias of California.

AMERICAN TREE MONARCHS, by American Forestry Association. In *Ameri-can Forests*, April—September, 1951. 13 pages.

List of nearly 300 individual trees, each the largest of its kind known in this coun-try. Circumference, height, spread, location, and nominator of each tree.

THE TREES OF PENNSYLVANIA, by William Carey Grimm. Published by Stackpole and Heck, New York, 1950. 377 pages. \$5.

A popular manual, including most of the trees of the northeastern United States, both the native ones and the commoner in-troduced ones. Keys for summer and for winter. Drawings of important features—leaves, twigs, buds, fruits, flowers.

PLANTS OF BIG BEND NATIONAL PARK, by W. B. McDougall and Omer E. Sperry. Published by the United States Government Printing Office, Washington, D. C., 1951. 221 pages. \$1.

Photographs, drawings, keys, and de-scriptions to help visitors identify the plants of this 700,000-acre park on the boundary between Texas and Mexico.

WILD FLOWERS, how to know and en-joy them, by Samuel H. Gottscho. Pub-lished by Dodd, Mead, New York, 1951. 192 pages. \$2.75.

Descriptions and photographs, in black and white and in color, of over 200 flowers, arranged by color and by season; symbols for kinds of localities and for conserva-tion hints.

FLOWERS, a guide to familiar Ameri-can wild flowers, by Herbert S. Zim and Alexander C. Martin. Published by Simon and Schuster, New York, 1950. 157 pages. \$1.

Descriptions and drawings (in color) of over 260 kinds, which the amateur is most likely to find. Flowers arranged by color.

NATIVE ORCHIDS OF NORTH AMER-ICA, by Donovan Stewart Correll. Pub-lished by Chronica Botanica, Waltham, Mass., and Stechert-Hafner, New York, 1950. 416 pages. \$7.50.

By a specialist; useful to the average naturalist and horticulturist as well as to the botanist. Description, culture notes, and drawing for every species; keys.

GROWING WOODLAND PLANTS, by Clarence and Eleanor G. Birdseye. Published by Oxford University Press, New York, 1951. 235 pages. \$4.

For amateurs and experienced gardeners; preparation and care of woodland gardens, large or small; collection and propagation of the plants, and utilization of the surplus; drawings, descriptions, and culture directions for 200 recommended wild plants.

Weeds

WEED SEEDLINGS, by Anna P. Kummer. Published by University of Chicago Press, 1951. 469 pages. \$5.

Descriptions and drawings of 300 common or important kinds, with key for identification.



and Flower Arrangement

CARE OF HOUSE PLANTS, by Henry M. Bickart. New Jersey Agricultural Experiment Station (New Brunswick) Circular 542, Oct., 1951. 15 pages.

What they need and how to keep them thrifty.

ALL ABOUT AFRICAN-VIOLETS, by Montague Free. Published by Doubleday, Garden City, N. Y., 1951. 304 pages. \$3.50.

For amateurs; how to grow these plants in the house or in the greenhouse; photographs of methods and varieties, and reproductions of water colors of flowers and leaves.

HOW TO GROW AFRICAN-VIOLETS, by Carolyn K. Rector. Published by Lane, San Francisco, 1951. 94 pages. \$1.35.

For beginners, by one who learned by experience; drawings.

NEW SEEDS OF AFRICAN-VIOLETS, by Evan Roberts. In *Popular Gardening*, Jan., 1951. 1 page.

Creeper, climb, and hang.

MUSHROOMS OF EASTERN CANADA AND THE UNITED STATES, by René Pomerleau and H. A. C. Jackson. Published by Chantecler, Montreal, 1951. 302 pages. \$9.

A simple guide for amateurs; descriptions of the commonest and best edible kinds; how to collect and prepare them; characteristics of the poisonous ones; keys for identification; photographs and drawings, in black and white and in color.

EVALUATION OF A SELECTIVE CRABGRASS KILLER, by Robert W. Schery. In *Missouri Botanical Garden Bulletin*, April, 1951. 8 pages.

Sentil (or phenyl mercuric acetate), new hope for busy homeowner.

GROWING AND ENJOYING SUCCULENTS, by Ladislaus Cutak. *Missouri Botanical Garden Bulletin*, Dec., 1950. 25 pages.

Propagation, grafting, seasonal care, diseases and pests; choice of kinds; desertariums and dish gardens.

THE NEW FLOWERING-MAPLE, by Joy Logee Martin. In *Flower Grower*, Nov., 1951. 2 pages.

Grown from seeds or cuttings.

REX BEGONIA SEED ON SPHAGNUM MOSS, by B. Y. Morrison. In *The National Horticultural Magazine*, July, 1951. 3 pages.

A better and easier method.

HYBRID GLOXINIAS, by Paul F. Frese. In *Popular Gardening*, Nov., 1951. 4 pages.

Story of Albert H. Buell's strains; how to grow them.

THE JOY OF FLOWER ARRANGING, edited by Helen Van Pelt Wilson. Published by Barrows, New York, 1951. 253 pages. \$3.95.

Photographs and descriptions of the work—for different months—of twelve arrangers from different states; for the home—seasonal material.

CORSAGE CRAFT, by Glad Reusch and Mary Noble. Published by Van Nostrand, New York, 1951. 157 pages. \$3.50.

A practical manual; design; growing and conditioning the material; preparing and assembling the flowers, leaves, berries, pods, cones; bouquets. Photographs and diagrams.



Artistic lighting on tropical water-lily pool at Members' party

WITHIN THE BROOKLYN BOTANIC GARDEN

THREE-HOUR TRIP TO AFRICA

"The Lure of the Dark Continent" was the unusual theme for the Fall Party and Annual Meeting for Members and Guests on October 17. Both lecture and exhibits were planned to feature things African.

Near the Garden entrance to the Administration Building, artistic lighting was focused on the tropical water-lily pool and the adjacent heavily fruited ornamental crab apples.

One of the outstanding indoor exhibits was that of African wood by Garden Member George Dayton of the J. H. Montearth Company. Among the features were low mahogany tables with handsome carved elephants for legs; panels of many kinds of rare African wood; large blocks from the logs; and interesting data about the trees themselves.

Adjoining the wood exhibit was a gallery of flower paintings by Members who had been students in the Garden's course in painting.

In the Rotunda were flower arrangements "Speaking of Africa," made by members of Brooklyn garden clubs. Only plants native to Africa were used, with

gladiolus, bird-of-paradise flower (*Strelitzia*), and aloes, predominating.

Many of the plants that thrive indoors in this part of the world originated in Africa. With this in mind, a clever exhibit was arranged to imitate an indoor window garden of common and unusual house plants—each one labeled.

Recent discoveries of the Garden's Scientific Research Staff were on display, with equipment and posters, and staff members on hand to explain.

At 8:30 P.M. a capacity audience gathered in the auditorium, to be led "Across the Belgian Congo" by Dr. Adrian Van Sinderen. This was the first public showing of the color pictures of his unusual expedition in the Dark Continent.

Refreshments were served in the Rotunda, and Members had opportunity to renew acquaintance and to introduce new friends to the Garden.

As Members and guests left the building at the end of the evening, each one received a handful of ivy, and each Member was given a potted specimen of a dwarf Japanese holly plant (*Ilex crenata helleri*).

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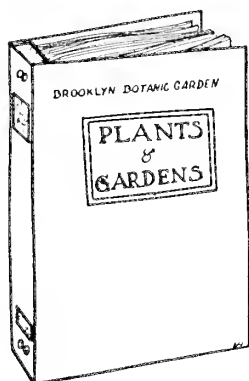
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